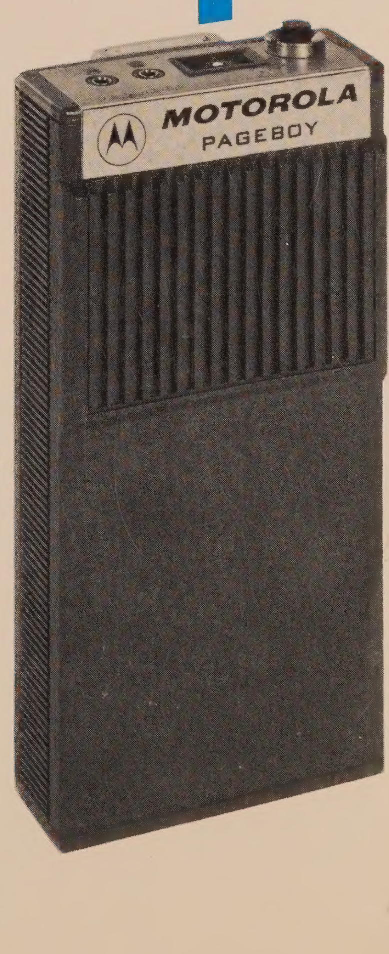
MOTOROLA

TONE AND VOICE
PAGEBOY
RADIO PAGER

406-420 MHz
450-470 MHz



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MOTOROLA

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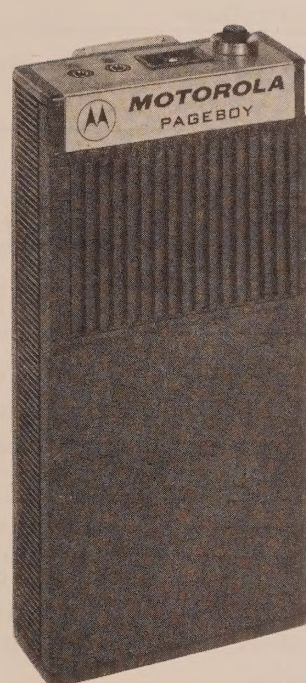

MOTOROLA INC. Communications Division

ENGINEERING PUBLICATIONS 8000 WEST SUNRISE BOULEVARD FT. LAUDERDALE, FLORIDA 33322

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Issue-F

PERFORMANCE SPECIFICATIONS

MODELS	H04BNC Series
FREQUENCY	406-420 MHz, 450-470 MHz
MODULATION ACCEPTANCE	±5 kHz
CHANNEL SPACING	25 kHz
SELECTIVITY	more than 50 db at ±25 kHz
NUMBER OF TUNED CIRCUITS	13 circuits
20 dB QUIETING SENSITIVITY	less than 0.55 microvolt, 50 ohms rf input impedance
PAGING SENSITIVITY	tone-operated, less than 0.15 microvolt; 50 ohms rf input impedance
SEMICONDUCTOR COMPLEMENT	25 transistors 8 diodes 1 silicon controlled switch (Automatic Listen models only)
BATTERY DRAIN	11.0 mA (standby) 90.0 mA (150 mw audio output -- carrier modulated with 1000 Hz tone)
SPURIOUS AND IMAGE REJECTION	more than 40 dB (except $f_o = f_c$ - 910 kHz, which is more than 35 dB)
FREQUENCY STABILITY	crystal-controlled oscillator maintains frequency within ±.0005% of reference frequency at -10°C to +50°C ambient temperature (+25°C reference)
AUDIO OUTPUT	150 milliwatts to an 8-ohm load at less than 10% distortion (3.7 V supply voltage)
BATTERY COMPLEMENT	(1) NLN6431A Nickel-Cadmium Battery Kit (rechargeable) or (1) NLN6811A Nickel-Cadmium Battery Kit (rechargeable; U.L. Approval) or (1) NLN6430A Mercury Battery Kit (consisting of one 4.2-volt E-133 Mercury Cell)
WEIGHT (without external accessories)	11-1/4 oz. with nickel-cadmium battery 11-1/2 oz. with mercury cells
DIMENSIONS	5-1/4" x 2-1/2" x 1-1/16" (not including clip)
BATTERY LIFE (Based on 15 ten-second paging calls in an eight-hour period)	nickel-cadmium: 12 hours with each charge mercury cells: 90 hours continuous operation.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FOREWORD

SCOPE OF INSTRUCTION MANUAL

This manual offers descriptive data and service information for the equipment listed. Service diagrams, parts lists, and printed circuit board details are also part of this instruction manual.

NOMENCLATURE

Motorola equipment is specifically identified by the model number on the nameplate.

NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision number is assigned to the chassis or kit affected; -1, -2, -3, etc.

The chassis number complete with revision number, if any, is stamped on the chassis at the time of production. The revision number becomes an integral part of the chassis identifier. Revisions, if any, are listed on the schematic diagram.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change indlucing pertinent parts listing data.

NATIONAL SERVICE ORGANIZATION

Motorola provides a nation-wide service organization. Through its maintenance and installation program, Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

Motorola's National Service Organization is the largest service organization specializing in mobile communications. It includes over 800 independently owned and operated service stations, strategically located and manned by a force of several thousand FCC licensed personnel.

The area administrative forces, district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Division
1301 Algonquin Road, Schaumburg, Illinois 60172
Tel. 312-358-7900 TWX 910-693-1595

CAREFUL USE OF THIS INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED EQUIPMENT. REFER ANY QUESTIONS CONCERNING THIS MANUAL TO THE ENGINEERING PUBLICATIONS DEPARTMENT AT THE ADDRESS SHOWN ON THE TITLE PAGE.

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REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola maintains parts and service depots and authorized service stations strategically located throughout the country. These facilities are fully equipped to give the finest service. Orders for all parts except crystals, channel elements, "Vibrasender" and "Vibrasponder" resonant reeds, "Permacode" active filters, and "Permacode" Code Plugs should be sent to the nearest parts depot. Orders for instruction manuals should also be sent to the parts depot.

When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and assure delivery of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal and channel element orders should specify the crystal or channel element type number, crystal frequency, carrier frequency, and the chassis model number in which the part is used.

Orders for "Vibrasender" and "Vibrasponder" resonant reeds, and "Permacode" active filters should specify the type number and frequency and should identify the owner/operator of the communications system in which these items are to be used.

Orders for programmed "Permacode" Code Plugs should specify desired code.

PARTS DEPOT

2333 Utah Ave, El Segundo, CA 90245
Tel: 213-644-1101, TWX: 910-348-6278

1170 Chess Drive, Foster City, San Mateo, CA 94404
Tel: 415-349-3111, TWX: 910-375-3877

P.O. Box 368 - Decatur, GA 30031
Street Address: 5096 Panola Industrial Blvd.
Decatur, GA 30032
Tel: 504-981-9800, TWX: 810-766-0876

10 W. North Ave, Lombard, IL 60148
Tel: 312-620-3000, TWX: 910-693-1592

85 Harristown Rd, Glen Rock, NJ 07452
Tel: 201-447-4000, TWX: 710-988-5602

3320 Belt Line Rd, Dallas, TX 75234
Tel: 214-241-2151, TWX:910-860-5505

12955 Snow Road, Parma, OH 44130
Tel: 216-267-2210, TWX: 810-421-8845

Airport Investment Bldg, 6701 Elk Ridge Landing Rd.
Linthicum, MD 21090
Tel: 301-796-8660, TWX: 710-862-1941

FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, RESONANT REED, AND "PERMACODE" ACTIVE FILTER ORDERS.

AIR MAIL ORDERS

Motorola, Inc.
Component Service Department
P. O. Box 66191
O'Hare International Airport
Chicago, IL 60666

REGULAR MAIL ORDERS AND CORRESPONDENCE

Motorola, Inc.
Component Service Department
2553 Edgington Street
Franklin Park, IL 60131
Tel: 312-451-1297, TWX: 910-227-0799

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TABLE OF EQUIVALENT UNITS

UNIT	ABBREVIATIONS	REPLACES
hertz	Hz	cycles-per-second
kilohertz	kHz	kilocycles-per-second (kc)
megahertz	MHz	megacycles-per-second (Mc)
picofarad	pF	micromicrofarad (uuF)

CONTENTS

DESCRIPTION AND OPERATION

1. DESCRIPTION

The Motorola "Pageboy" Radio Pager is a completely transistorized, dual conversion FM receiver which operates in the 406-420 or 450-470 MHz frequency range for use in Motorola selective radio paging systems. An alerting tone and voice message are emitted by this "People Finder" unit when actuated. It is battery operated and equipped with internal antenna, speaker, power switch and volume control. It may be carried in a pocket, a special leather case (see ACCESSORIES), or clipped on a belt.

The pagers are available in "automatic listen" and "push-to-listen" versions as listed in the model chart at the front of this manual. The voice message automatically follows the alerting tone in the "automatic listen" models while a button must be pressed and held to hear the voice message in "push-to-listen" versions. The voice message level is adjustable by an external volume control on all models. On some versions the alerting tone level, in addition to the voice message, is adjustable by using the external volume control. This is also indicated on the model chart.

This pager is used as part of a Motorola selective radio paging system. Selective call circuitry allows the receiver to respond only upon reception of two code tones transmitted in sequence from an associated radio paging base station.

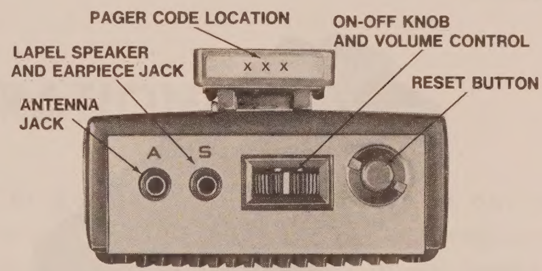
The receptacles (jacks), mounted on the top of the pager housing, allow the pager to be used with an external antenna and an external speaker or earpiece. Each receptacle is identified by a letter stamped on the pager housing; the "A" indicates the antenna jack, the "S" indicates the speaker jack. A corresponding letter is stamped on the plug of the accessory. When the lapel speaker or earpiece is connected to the pager, the built-in speaker is disconnected from the audio output. Refer to the ACCESSORY TABLE of this manual for a complete listing of the accessories.

2. PRE-OPERATIONAL NOTES

Remove the pager from the shipping container and inspect for possible damage. Install the battery as described in the battery replacement paragraph of the BATTERY REPLACEMENT AND CHARGING section of this manual. Test each unit for proper operation in the system. Record the pager code from the code card on the clip. Instruct the operator in proper use and care of the unit.

NOTE

The shipping carton should be retained for storage of units when not in use and for shipping or transporting unit if service is required.



Control Location Detail

3. OPERATION

a. <u>"Automatic Listen" Models</u>

(1) Plug in external antenna and/or speaker if desired.

(2) With the speaker facing the operator, turn volume control to right until a "click" is heard.

(3) Press reset-listen button.

(4) Adjust volume control with received message for desired loudness. This control does not affect tone level on fixed alert tone models.

(5) Press and release reset-listen button following voice message to return unit to "standby".

(6) Rotate volume control to left until "click" is heard to turn unit off.

CAUTION

Turn unit off when leaving unattended to prevent activation and unnecessary battery drain.

b. "Push-to-Listen" Models

(1) Plug in external antenna and/or speaker if desired.

(2) With the speaker facing the operator, turn volume control to right until "click" is heard.

(3) When alert tone is heard, press and hold reset-listen switch to hear voice message.

(4) Adjust volume control for desired loudness while receiving voice message. This control does not affect tone level on fixed alert tone models.

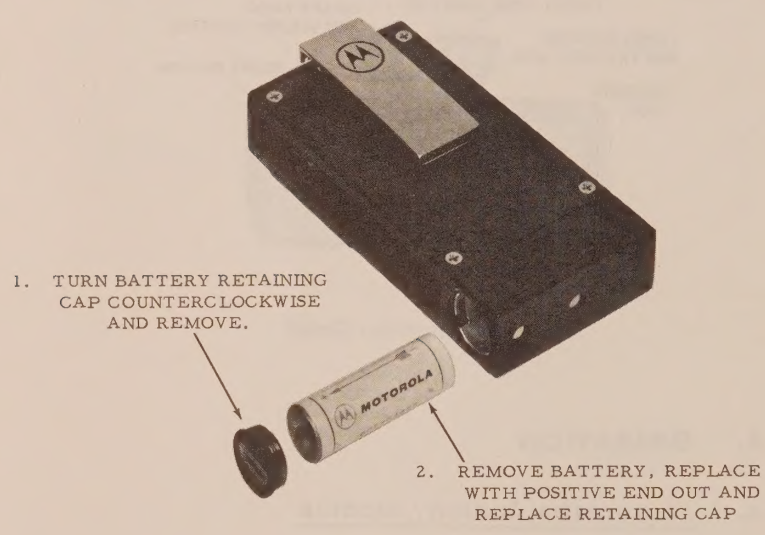
(5) Rotate volume control to left until "click" is heard to turn unit off.

BATTERY REPLACEMENT AND CHARGING

1. BATTERY REPLACEMENT PROCEDURE

WARNING

Do not discard mercury or nickel-cadmium batteries in fire as they may explode.



2. NICKEL-CADMIUM BATTERY KIT

The rechargeable NLN6431A and NLN6811A Nickel-Cadmium Batteries are used with the "Pageboy" Radio Pagers as shown in the preceding Model Chart. The NLN6811A Battery is U. L. approved.

a. General

The battery consists of three emergency vented type cells connected in series to obtain a nominal 3.9 volts.

CAUTION

Avoid accidental short circuits. Sustained short circuits will activate the emergency vent and shorten the life of the battery.

The voltage under load of a nickel-cadmium battery remains approximately constant until the battery approaches the discharged condition. At this time, a marked decrease in this voltage occurs and the discharged condition (1.0 volt per cell) is reached abruptly. It is difficult to determine the state of charge of this type of battery with a meter, therefore, this is not normally performed.

A characteristic of rechargeable batteries is self-discharge during the storage period. If the battery is to be used after an unknown period of storage, it is recommended that it be charged continuously for at least 16 hours using an approved charger.

b. Charging

The ACCESSORY TABLE of this manual lists the battery chargers to be used for recharging the battery. The battery can be charged either in or out of the pager housing. The use of other equipment in recharging may result in damage and will void the guarantee.

The battery does not require the addition of electrolyte. The only maintenance necessary is recharging the battery and keeping its contacts clean.

c. Storage

The battery requires no special storage precautions. It may be stored at normal room

temperatures in any state of charge without detrimental effects.

d. Guarantee

The manufacturer will replace without additional cost during the first year of service, all batteries which fail to deliver 70% (84 mA hours) of their rated capacity at 68°F or develop apparent leakage.

(1) Limitations to Guarantee

The guarantee becomes VOID if:

(a) Equipment other than that approved by the manufacturer is used to charge the batteries.

(b) Charging is done at temperatures greater than 122°F without proper instructions from the manufacturer.

(c) Batteries are used in equipment or for services other than that for which they were intended.

(d) Maximum discharge rates are exceeded.

(2) Capacity Test

(a) The battery shall first be completely discharged through a 30-ohm resistive load until the load voltage is less than 1.0 volt.

(b) It shall then be charged at a constant current of 14 mA for 16 hours using an approved charger.

(c) It shall then be discharged 2 hours after charging, at 68°F through a 30-ohm resistive load.

(d) The minimum discharge time to the level of 3.0 volts dc shall be 42 minutes. A battery whose terminal voltage drops below 3.0 volts before 42 minutes has less than 70% of rated service capacity and will be replaced under the provisions of the guarantee stated previously.

THEORY OF OPERATION

1. TONE CODING FOR PAGER SELECTION

a. Introduction

The Motorola "Pageboy" encoding method uses a two-tone sequential system. The first tone, designated tone A, is transmitted for one second. Within 300 milliseconds after tone A, a second tone, designated tone B, is transmitted for three seconds.

There are 90 unique tone frequencies from which tone A and tone B can be selected. Each tone is assigned a three-digit number. This number is usually referred to as the "reed code" and is stamped on the top of each TLN6709B "Vibrasponder" resonant reed. The corresponding tone frequency is stamped on the nameplate of the reed. The reed for tone A plugs into the "1" position of the receiver's reed socket and the reed for tone B plugs into the "2" position of the socket.

b. General Encoding Method

Each "Pageboy" receiver is also assigned a three-digit number referred to as the "pager code" The relationship between the pager's code and the reed codes which are assigned to tone A and tone B is the general encoding method.

The general encoding method is developed to two steps. Fifty unique tone frequencies are divided into five groups of 10 tones each. These groups are numbered sequentially and are designated "reed group 1", "reed group 2", etc. Table 1 illustrates the reed group division, the associated reed code and the number of the tone in each group. The first digit of the three-digit pager code selects the reed groups from which tone A and tone B are to be selected. The arrangement which associates the first digit of the pager code with the specific reed groups from which tone A and tone B are respectively selected was arbitrary. The arrangement which has been selected for use with the Motorola "Pageboy" receivers and encoders is illustrated in Table 2. The remaining two digits of the three-digit pager code are the numbers of tone A and tone B respectively.

Therefore, to determine which frequencies or reed codes are associated with a given pager code, find out from Table 2 and the first digit of the pager code, the reed groups from which tone A and tone B are selected. Then from Table 1 and the remaining two digits, find the tone frequency or reed code which corresponds to each digit or tone number.

c. Alternate Receiver Selection

In some dial interconnect terminals there is a provision for substituting spare receivers into the system should any of the "on-line" receivers be out of service. The receiver substituted into the system must use a coding method different than the general encoding method described in paragraph b. General Encoding Method.

The spare receivers are identified by an alternate pager code which has the same second and third digits, e.g. 122. The alternage pager decoding method uses the first digit to select tone A directly and the reed group from which tone B is selected. The third digit of the alternate pager code is the tone number of tone B selected from the reed group associated with the first digit in Table 3. Table 3 illustrates the alternate pager decoding method. The reed groups referenced for tone B are the same as in Table 1.

To find the tone frequencies or reed codes corresponding to an alternate pager code, use Table 3 and the alternate pager code's first digit to determine tone A and the group from which tone B is selected. Then use Table 1 and the alternate pager code's third digit to determine tone B.

Example:

Given alternate pager code 355

Tone A: Reed Code 130 (979.9 Hz)

Tone B: Reed Code 125 (746.8 Hz)

d. Code Assignment Type Encoding Method

The Code Assignment Type Encoding Method was developed to accommodate high capacity systems. To accomplish high capacity, an additional 40 unique tone frequencies are added to the original 50 unique tone frequencies. These new frequencies are assigned to Reed Group 6 (Table 1) and to Code Type Y Groups (Table 5).

Each "Pageboy" receiver is assigned a letter prefix three-digit number referred to as the "pager code". The relationship between the pager's code and the reed code which are assigned to the First Tone and the Second Tone is the Code Assignment Type Encoding Method. Therefore, to determine which frequencies or reed codes are associated with a given pager code, find out from the Code Assignment Type Table (Table 4) the code type which corresponds with the letter prefix of your pager. EXAMPLE: Assume your pager has a pager code D345. Proceeding downward we find a two-number assignment (12). The first number (1) identifies the reed group for the first tone and the second number (2) identifies the reed group for the second tone.

Then from Table 1 and the remaining two digits, find the tone frequencies or reed code which corresponds to each digit or tone number. For the above pager code D345 we determine:

First Tone: Reed Code 114 (410.8 Hz)

Second Tone: Reed Code 125 (746.7 Hz)

Table 1. Reed Groups

TONE NUMBER *	REED GROUP 1		REED GROUP 2		REED GROUP 3 (OR A)		REED GROUP 4		REED GROUP 5		REED GROUP 6	
	REED CODE	FREQ. Hz	REED CODE	FREQ. Hz	REED CODE	FREQ. Hz	REED CODE	FREQ. Hz	REED CODE	FREQ. Hz	REED CODE	FREQ. Hz
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.8	191	1153.4
2	112	368.5	122	634.5	108	296.5	142	358.6	152	617.4	192	1185.2
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8
4	114	410.8	124	707.3	109	313.0	144	399.8	154	688.3	194	1251.4
5	115	433.7	125	746.8	160	953.7	145	422.1	155	726.8	195	1285.8
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2
7	117	483.5	127	832.5	161	1006.9	147	470.5	157	810.2	197	1357.6
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5

* (2nd or 3rd digit of page code)

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Table 2. General Encoding Plan

FIRST DIGIT OF PAGER CODE	GROUP FROM WHICH TONE A IS SELECTED	GROUP FROM WHICH TONE B IS SELECTED
1	1	1
2	2	2
3	1	2
4	4	4
5	5	5
6	2	1
7	4	5
8	5	4
9	2	4
0	4	2
A	3	3

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Table 3. General Alternate Pager Code Plan

FIRST DIGIT OF ALTERNATE PAGING CODE	TONE A REED CODE FREQUENCY		REED GROUP FROM WHICH TONE B IS SELECTED
1	160	953.7	1
2	160	953.7	2
3	130	979.9	2
4	160	953.7	4
5	160	953.7	5
6	130	979.9	1
7	130	979.9	5
8	130	979.9	4

EPD-26704-B

Table 4. Code Assignment Type Encoding Plan

FIRST DIGIT	CODE TYPE																				
	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	Y
1	11	11	11	11	11	11	11	11	11	11	23	23	23	24	24	25	34	34	35	46	AA
2	22	22	22	22	13	13	13	14	14	15	22	22	22	22	22	22	43	43	53	64	BB
3	33	12	12	12	33	33	33	41	41	51	33	33	33	42	42	52	33	33	33	56	ZZ
4	12	44	15	21	44	31	31	44	44	16	44	32	32	44	44	26	44	44	36	44	AB
5	13	14	55	16	31	55	16	55	16	55	32	55	26	55	26	55	55	36	55	55	AZ
6	21	21	21	66	14	15	66	15	66	66	24	25	66	25	66	66	35	66	66	66	BA
7	31	41	51	61	41	51	61	45	61	61	42	52	62	45	62	62	45	63	63	45	ZA
8	23	24	25	26	34	35	36	54	46	56	34	35	36	54	46	56	54	46	56	54	BZ
9	32	42	52	62	43	53	63	51	64	65	43	53	63	52	64	65	53	64	65	65	ZB

EPD-26702-A

Table 5. Code Type "Y" Reed Groups

TONE NO.*	A SERIES		B SERIES		Z SERIES	
	REED CODE	FREQ Hz	REED CODE	FREQ Hz	REED CODE	FREQ Hz
1	DA	398.1	DB	412.1	DZ	384.6
2	EA	441.6	EB	457.1	EZ	426.6
3	FA	489.8	FB	507.0	FZ	473.2
4	GA	543.3	GB	562.3	GZ	524.8
5	HA	602.6	HB	623.7	HZ	582.1
6	JA	668.3	JB	691.8	JZ	645.7
7	KA	741.3	KB	767.4	KZ	716.7
8	LA	822.2	LB	851.1	LZ	794.3
9	MA	912.0	MB	944.1	MZ	881.0
0	CA	358.9	CB	371.5	CZ	346.7

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* = 2nd or 3rd digit of pager code.

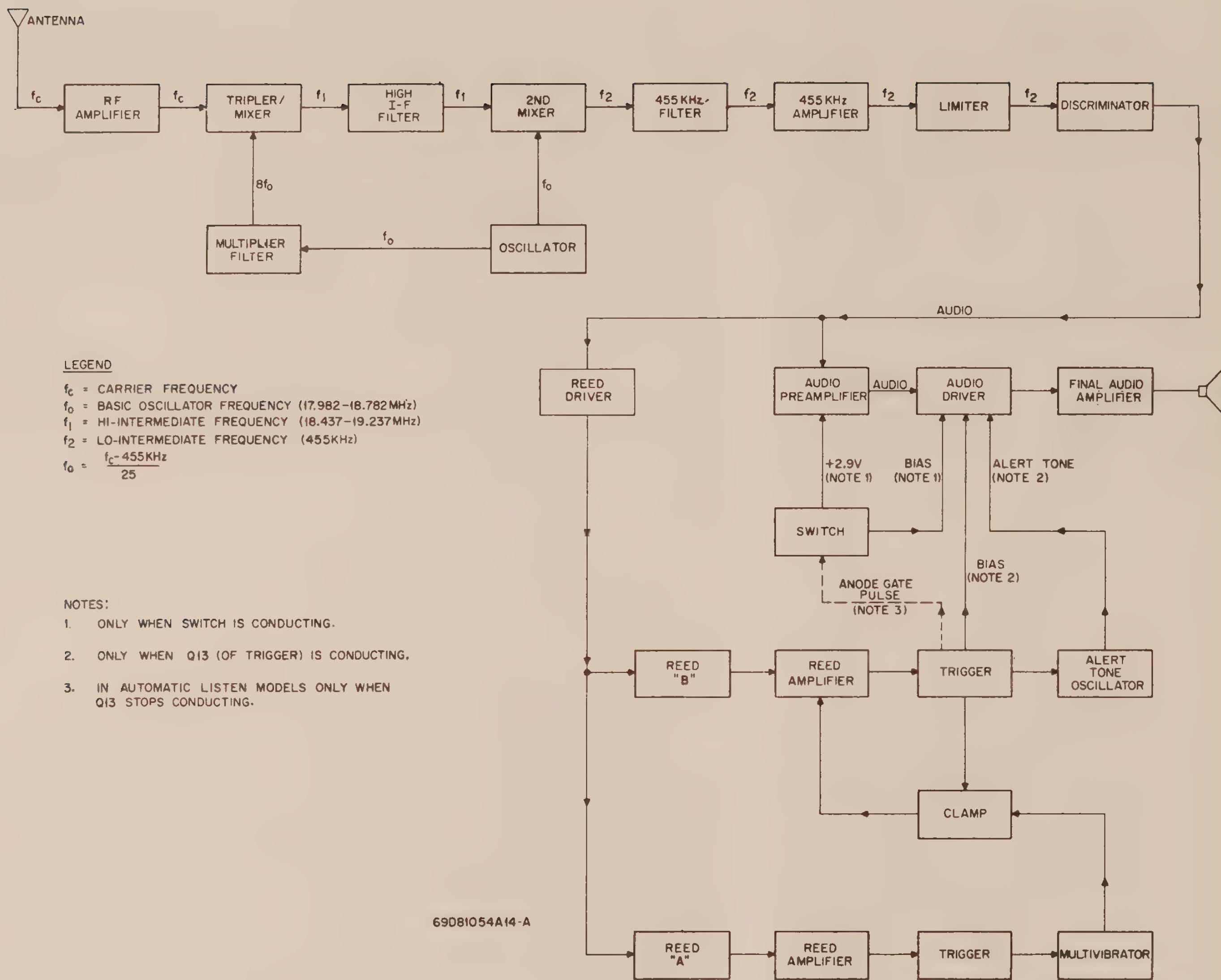


Figure 1. Pager Block Diagram

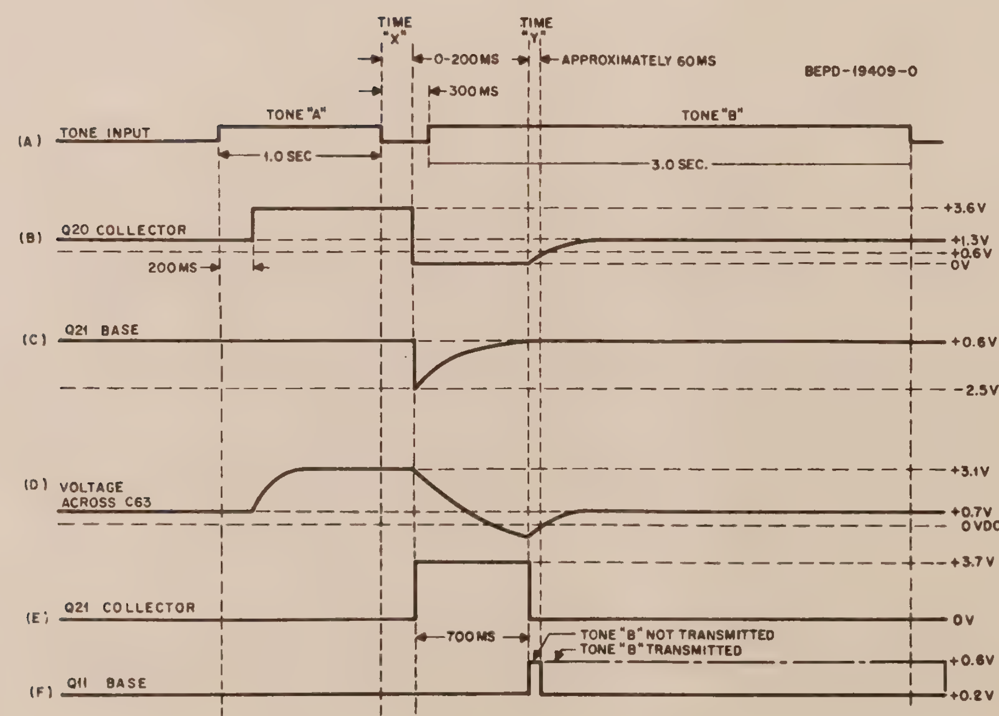


Figure 2. Waveform Detail

2. CIRCUIT DESCRIPTION

Refer to Schematic Diagram 63E81052A61 and to the block diagram for stage-by-stage signal flow and operating frequencies. The antenna is the escutcheon at the top of the radio pager. The antenna (escutcheon) is matched to the base of the r-f amplifier, Q1, by the tuned circuit C1, L1. Tuned Circuit C1, L1 also provides initial selectivity ahead of Q1. The r-f signal is amplified by Q1. Additional selectivity to the r-f signal is obtained by coupling the signal to the tripler/mixer, Q2, through a three-stage aperture coupled filter L2, L3 and L4. The output coil of the filter, L4, is tapped to match the base of Q2. The shunt capacitance of the Q2 base is also used to tune coil L4.

An injection signal which mixes with the r-f signal in the base circuit of Q2, originates from the oscillator circuit, Q4. This oscillator is a modified Colpitts type with a series tuned feedback circuit, Y3, L7. Frequency stability is determined by the crystal, Y3. The frequency of the oscillator can be changed an incremental amount (warped) by changing the inductance of L7.

A tuned circuit, L6, C22, in the emitter circuit of Q4 selects a frequency eight times that of the basic oscillator frequency. This signal is coupled through another tuned circuit, L5, C7, and is then injected to the base of Q2. The third harmonic of this signal (24th harmonic of the basic oscillator frequency) is produced in the base circuit of transistor Q2 and mixed with the incoming r-f signal to produce the first (high) intermediate frequency.

This i-f signal is fed through a high i-f filter consisting of L8, C8, C9, L9, C10, C12 and C13 to the base of Q3, the second mixer. The signal in this stage is mixed with the basic frequency from the oscillator to produce the second i-f frequency of 455 kc. The 455 kc signal is fed through a ceramic filter and amplified in the 455 kc amplifier IC1. The output from this amplifier is fed through the limiter Q5 to the discriminator stage. Here the frequency variations of the i-f signal are translated into an audio frequency.

When paging tones are received, they are coupled through the reed driver, Q6, and applied to the "Vibrasponder" resonant reeds. Each reed is activated by its particular tone code. These tones, designated A for the first and B for the second, must arrive in the proper sequence in order to provide the alert tone at the speaker. Tone A is transmitted for one second followed within 300 milliseconds by three seconds of tone B.

The "Vibrasponder" resonant reeds used are of the two coil, single tine type. If a tone is applied to the input coil equal in frequency to that of the mechanical resonance of the "Vibrasponder" reed, the reed will vibrate strongly, acting as the electro-mechanical coupling device between the input and output coils. Therefore, each reed can be considered to be a very narrow bandpass filter which passes only the desired paging tone.

When tone A is received, it is passed through "Vibrasponder" reed A to the base of Q17, the reed amplifier. The tone is amplified and coupled through C59 to the base of Q18. Transistors Q18 and Q19 form a trigger circuit and are both normally cut-off. When the input is received at the base of Q18, the transistor begins to conduct and its collector goes negative (i.e., less positive). This transition is coupled through R56 to the base of Q19 causing it to conduct and its collector to go positive (less negative). This positive transition is coupled through R54 back to the base of Q18, increasing its forward bias and causing greater conduction. The positive potential at the collector of Q19 provides forward bias for CR8 allowing it to conduct and the potential to be felt at the collector of Q20. Capacitor C61 along with resistor R56 also delays the action of the trigger circuit by approximately 200 usec. This delay reduces the probability of activation of the first trigger circuit by voice messages.

Q20 and Q21 form a basic monostable multivibrator circuit, with Q20 normally cut off and Q21 conducting (saturated). Figure 2 illustrates the waveforms at various points in the multivibrator and clamp circuits during the "on" and "off" times of tone A and the start of tone B transmission. Prior to the conduction of CR8, the potential at the collector of Q20 is approximately 1.3 volts dc, being established by the resistive divider network consisting of R60 and R61. This voltage is fed through R58 to the base of Q14, the clamp stage, providing forward bias for the transistor and allowing it to conduct to saturation. The path of conduction of Q14 is from ground through resistor R46, the transistor. resistors R39 and R40 in the base-collector circuit of Q11 to the B+ supply. The base of Q11 is effectively clamped to approximately

zero volts (through transistor Q14), thereby cutting off the transistor. With Q11 cut off, the trigger circuit (consisting of Q12 and Q13) cannot operate, which in turn, keeps the tone oscillator (Q15 and Q16) de-activated. Since the tone oscillator is de-activated until tones A and B arrive in proper sequence, false paging is prevented.

When CR8 conducts, the voltage at the collector of Q19 is coupled to the collector of Q20 increasing its potential to 3.6 volts dc (shown as waveform B in Figure 1). As noted previously, Q21 is normally conducting and remains conducting throughout the increase in potential at the collector of Q20. A forward bias of 0.6 volt dc is established at the base of Q21 through its emitter-base junction and R62. With the potential at the collector of Q20 at 3.6 volts and the base of Q21 at 0.6 volt dc, the effective potential across C62 increases from its normal value of 0.7 volt to 3.0 volts dc. (See waveform D in Figure 1.)

The multivibrator will remain in this state for the remainder of tone A transmission and the time period shown as "X" on the waveform detail (time "X" is the period required for the "Vibrasponder" reed to stop vibrating once tone A has stopped). At the end of this period, the trigger circuit (Q18 and Q19) will revert to its former condition (i.e., both transistors cut off). The collector of Q19 will return to zero and CR8 will again be back-biased, cutting the diode off. When this occurs, the collector of Q20 tends to return to 1.3 volts, thus generating a negative going transition which is coupled through C62 to the base of Q21, cutting it off. Its collector now approaches the 3.6 volt supply potential. This positive transition is fed through R64 to the base of Q14, sustaining the forward bias previously established through R58 and keeping the transistor conducting. This will, as described previously, keep amplifier Q11 cut off and the trigger (Q12 and Q13) and tone oscillator de-activated. The positive transition at the collector of Q21 is also coupled through R59 to the base of Q20, driving it into saturation. The collector of Q20 will approach zero potential. C62 now begins to discharge then slightly reverse charge through Q20 and R62. When the voltage reaches 0.6 volt, Q21 will again conduct, the collector will return to zero potential, and Q20 will be cut off. The collector of Q20 will now attempt to return to its normal cut off potential of 1.3 volts. However, due to the charging of C62, this action is not accomplished instantaneously. Therefore with the collector of Q21 at zero and the collector of Q20 in transition from zero potential, a short period of time exists (shown as time "Y" on the waveforms in Figure 1.) when there is no positive forward bias applied to Q14, the clamp stage. In this time period, Q14 will be cut off and the amplifier, Q11 will conduct (see waveform F in Figure 1). Tone B will now pass through "Vibrasponder" B to the base of Q11. Operation of the amplifier, Q11, and the trigger circuit, Q12 and Q13 is essentially the same as described previously for amplifier Q17 and the trigger circuit consisting of Q18 and Q19. However, as Q13 conducts, its collector goes positive, applying reverse bias to the emitter-base junction of Q14, (the clamp stage), sustaining its cut off condition and permitting Q11 and the succeeding stages to continue functioning throughout the duration of tone B transmission. In addition, as the collector of Q13 goes positive, power is applied to the tone oscillator (Q15 and Q16) causing it to oscillate. The generated tone is then coupled through C54 and JU1 or JU2 into the audio circuitry. If the alerting tone is routed through JU1, it is applied directly to the audio driver; if through JU2, it is routed through the volume control, the audio driver and final amplifier stages.

Bias is provided for the audio driver, Q8, through R33 and R34 when Q13 goes into saturation and its collector swings positive to +3.7 volts. That is, when Q13 goes into saturation, it both turns on the tone oscillator and provides bias for the audio driver.

During the reception of tone B the multivibrator circuit will return to its former state (Q20 cut off, Q21 conducting). The collector of Q21 will go positive, applying a positive potential to the base of the clamp stage Q14. However, the reverse bias condition established by the conduction of Q13 exceeds the positive base potential and the clamp stage is kept in its cut off state for the remainder of tone B transmission. At the conclusion of tone B transmission, the clamp stage will again conduct, cutting amplifier Q11 off and de-activating the trigger and tone oscillator circuits. In "automatic listen" models the negative-going waveform at the collector of Q13 (+3.7 volts to 0 volt) is coupled through C42 to the anode gate of the silicon controlled switch, SCS1. SCS1 goes into conduction which causes 2.5 volts to appear at the cathode of this switch and which in turn causes Q7, the audio preamplifier, to conduct. Also, the audio driver Q8 is biased into conduction which provides audio output. This condition remains until the reset-listen switch, S1 is pressed and released, at which time the unit returns to standby and awaits the next selective tone code sequence. The unit returns to standby when the reset-listen switch is momentarily closed because a certain holding current must be maintained through the silicon controlled switch, SCS1 for it to continue to conduct. When the reset-listen

switch is closed, current is shunted through its contacts rather than through the silicon controlled switch SCS1 and the latter goes out of conduction.

The radio pager will go into the "listen" mode when the unit is first turned on, or when it is turned off and then on because a positive voltage is applied to the anode of the silicon controlled switch, SCS1 but the anode gate of this switch (which is connected to C42) cannot go instantly positive because of the charging time required by C42. This, in effect, amounts to a negative pulse applied to the anode gate which causes SCS1 to conduct.

Should the radio pager be in the "listen" mode for channel monitoring and it is paged, there will be a positive-going waveform at the collector of Q13 at the beginning of tone "B". This is applied through C42 to the anode gate of the silicon controlled switch, SCS1 which will turn this switch off. This disables the audio circuitry thereby preventing audio noise or tone "B" from distorting the alert tone. At the end of tone "B" the waveform again goes negative which turns on SCS1 and returns the pager to the "listen" mode.

In "push-to-listen" models, when the reset-listen switch is pressed, battery voltage is applied to the junction of R27 and R29. This causes audio pre-amplifier Q7 to conduct. At the same time, audio driver Q8 is biased into conduction. This continues until the reset-listen switch is released.

MAINTENANCE

1. TEST EQUIPMENT

All the required test equipment for aligning and testing the "Pageboy" radio pager is listed in the following Test Equipment Chart. The listed items or their equivalents may be used.

Test Equipment Chart

EQUIPMENT	USED FOR
High impedance dc voltmeter with rf probe; Motorola S1063B Solid-State DC Multimeter with rf probe	All dc measurements.
AC voltmeter - Motorola S1053C Solid-State AC Voltmeter	All ac signal measurements.
FM signal generator - Motorola S1341A or S1342A Signal Generator or equivalent with a 6 dB pad (type N output)	Alignment of all rf and high i-f stages, 20 dB quieting sensitivity measurements.
Frequency Meter - Motorola S1343A	Checking signal generator frequencies.
Digital Tone Generator - Motorola S1333A	Audio gain measurements and resonant reed checking. Generation of tone sequences.
455 kHz crystal-controlled oscillator - Motorola S1056B Test Set with 455 kHz crystal, or equivalent (Note 2)	Alignment of 455 kHz limiter and discriminator stages.
Motorola TEKA-83 Audio Adapter Cable (Note 3)	20 dB quieting sensitivity measurements and audio output measurements.
Motorola NEN6066A Test Jig	Holding the pager for alignment, keeping the push-to-listen switch depressed.
Motorola NLN6634A Tuning Tool Kit (supplied with the pager)	Adjusting the tuning coil slugs.
RF Adapter Cable (BNC to miniature phono) Motorola part number 30-84875H01	Coupling an rf signal to the pager external antenna jack (J1).

NOTES

1. A high impedance dc voltmeter with rf probe must be used for rf voltage measurements.
2. An equivalent crystal oscillator is available from International Crystal Mfg. Co. The oscillator consists of three parts which must be ordered separately: FOT-10 Oscillator Housing, OT-12 Circuit Board, and CY-6T Crystal.
3. The 4-ohm resistor supplied must be changed to 8 ohms.

2. TEST PROCEDURES

When a vhf radio pager requires servicing, use the following procedures to localize the fault.

a. Check Batteries

The first step in localizing the trouble is to check the battery voltage under load. With the pager turned on, check the battery voltage. This voltage should be not less than 3 volts for either the mercury cells or the nickel-cadmium battery. Even though the pager may operate at this lower voltage, its operation would be marginal and for only a short additional period of time. The recommended procedure is to replace, or recharge, the battery if the voltage is below the amount specified above. Refer to the BATTERY REPLACEMENT AND CHARGING section of this manual for additional information.

NOTE

Only the nickel-cadmium battery is rechargeable.

b. Check Overall Operation

If the battery voltage is sufficient, the next step is to check the overall performance of the pager. The pager should be placed in the recommended test jig (for holding purposes) and the checks listed below performed. This setup is illustrated on the Alignment Procedure sheet toward the back of this manual.

(1) Antenna Check

Check the circuit between the shield cans and the jack for continuity. Check for continuity between the emitter of Q1 and the housing escutcheon when the chassis is installed in the housing.

(2) Audio Switch Check, "Automatic Listen" Models Only

Turn the power on. Sound should be heard from the speaker indicating that the silicon controlled switch (SCS1) has turned on. Press the reset-listen button. The audio should remain on until the reset-listen button is released. When the reset-listen button is released, the audio should turn off, indicating that SCS1 has been deactivated.

NOTE

Under strong unmodulated carrier conditions, the receiver will be completely quieted and no sound will be heard even though the audio is on. Reducing the r-f level or applying modulation will cause sound to be heard if the audio is on.

(3) 20 dB Quieting Sensitivity Check

A good overall check of pager operation is the 20 dB quieting sensitivity measurement.

This check will indicate that the pager receiver has sufficient gain and that all the included circuitry is working properly. The quieting signal is that rf signal input necessary to reduce the audio output at the speaker by 20 decibels. The measurement should be made in the absence of extraneous signals. Since the pager is normally in the standby condition, the audio must be turned on while making this measurement.

The actual measurement is made by observing the noise voltage at the speaker on an ac voltmeter with no rf signal received at the antenna. This audio voltage may be metered by inserting an audio adapter cable with an 8-ohm resistive load into the speaker jack ("S") on the pager and connecting the cable to an ac voltmeter. If this test cable is not available, the pager cover must be removed and the audio output voltage monitored at test point M5 (refer to the test point detail). With no rf carrier applied to the pager, adjust the volume control for a reading of -3 dBm on the meter. Connect an rf signal generator to external antenna jack J1. The generator output level (at the proper pager frequency) is then increased until the audio output level is reduced to 1/10 of the previous (no carrier) reading. If all circuitry is operating properly, the quieting signal should be 0.5 microvolt or less.

(4) Paging Check

This check will test the selective call circuit response to a tone sequence. A paging call can be simulated using a Motorola S1333A Tone Generator and a Motorola S1341A or S1342A FM Signal Generator or S1327A Service Monitor. This check may be performed with the audio "on" or "off."

(a) Connect the rf output connector on the FM signal generator to the external antenna jack.

(b) Place the pager face down in the test jig for holding purposes only.

(c) Select the proper frequencies for tones "A" and "B" on the S1333A Tone Generator.

(d) Set the FM signal generator to the carrier frequency of the pager. Set the output level to 100 microvolts.

(e) Couple the output of the S1333A Tone Generator to the external modulation input jack on the signal generator. The FM signal generator should be adjusted to accept the external modulation as described in the instruction manual supplied with the signal generator or service monitor. Set deviation for 3.3 kHz.

(f) To simulate the paging tone sequence, depress the cycle clear button. The alert tone should now be heard at the speaker.

(g) The threshold of the paging circuit may be determined by reducing the rf signal level to a point where the unit ceases to page and then increasing the signal until it pages three times in succession. This level, as read on the dial of the FM signal generator, should be 0.15 microvolt or less.

(h) If the alert tone is not heard upon reception of the tone sequence, increase the rf input level. If the alerting tone is still not heard, and the 20 dB quieting sensitivity is within the specified limit, check the decoder circuitry.

(i) On "automatic listen" models only, the audio will turn on automatically when the alert tone ceases. If the unit is paged while in the listen condition, the silicon controlled switch will turn "off" when tone "B" is received. This disables the audio circuitry and prevents tone "B" from distorting the alert tone.

(5) Audio Check

(a) Connect the FM signal generator to the pager external antenna jack ("A") using the rf adapter cable (type N to phone plug).

(b) Set the FM signal generator to the carrier frequency of the pager. Set the generator output level to 100 microvolts. If the pager is being checked with the rear cover removed, the on-frequency condition may be verified by monitoring the discriminator test point. The reading at this test point should be zero volts when the signal generator is on the pager carrier frequency.

(c) Modulate the FM signal generator with a 1.0 kHz signal at 3.3 kHz deviation.

(d) Monitor the audio output at the external speaker jack ("S") using an audio adapter cable and an ac voltmeter. Turn the audio on and set the pager volume control for a reading of 1.1 volts ac on the ac meter.

(e) Check the battery terminal voltage with the reset-listen button depressed. This voltage should be no less than 3.7 volts. If it is less, insert a fresh battery.

(f) Monitor the audio output with a distortion analyzer (leave the audio cable connected). Distortion should be less than 10%. If a distortion analyzer is not available, monitor the audio output with an oscilloscope. The audio waveform should begin to "clip" at a reading of 1.1 volts ac on the ac voltmeter.

(g) If distortion is greater than 10%, check the dc voltage readings shown on the schematic diagram and the typical audio gain measurements.

3. STAGE ANALYSIS

The information contained in the following paragraphs will aid the serviceman in localizing the trouble to a particular stage.

a. Test Points

The test points on the printed circuitry are color coded for easy location. The locations of these test points may be seen on the alignment chart, the schematic diagram, and the wiring diagram at the back of this manual.

b. Stage Measurements Charts

In addition to the 20 dB quieting sensitivity measurement, all stage gain measurements can be checked against those shown in the following RF AND I-F STAGE MEASUREMENTS CHART and AUDIO AND REED AMPLIFIER MEASUREMENTS CHART pages 16 and 17.

c. DC Voltage Measurements

If the 20 dB quieting sensitivity voltage is greater than the value specified or the stage gain measurements are lower than those specified the dc voltages shown on the schematic diagram should be checked. These dc voltages are all referenced to ground.

CAUTION

When checking a transistor, either in or out of the circuit, do not use an ohmmeter having more than 1.5 volts dc appearing across the test leads or an ohms scale of less than X100.

NOTE

The transistor is a dependable component and is not subject to replacement as frequently as tubes. Therefore, the serviceman is cautioned not to replace transistors before a thorough check is made.

The transistor terminal voltages should be checked first. If these voltages are not reasonably close to those specified, the associated bias components should be checked. A low impedance meter should not be used for measurements. Instead, use the recommended Motorola dc multimeter, or equivalent dc voltmeter. If all dc voltages are correct, a signal should be traced through the circuit to show any possibility of breaks in the signal path.

d. RF Amplifier and Tripler/Mixer Analysis

Stage gain measurements as described in Paragraph b. Stage Measurements Charts should provide adequate indications of the rf amplifier and mixer stages performance. However, the rf signal coupled to the rf amplifier may be as large as possible and yet the presence of a signal in the receiver may not be detected. This situation may not indicate a failure of any stage. Mistuning of the injection multiplier coils, L5 and L6, will cause the mixer to have no conversion gain and the radio will appear to have failed completely. Before any alignment check or tuning of the radio is attempted, the tripler/mixer, Q2, injection must be checked. An indication of injection is the Q2 collector voltage at metering point M1 (brown). With adequate injection, this voltage should drop by at least 0.3 volt.

When tuning the three rf amplifier filter coils L2, L3 and L4, two definite peaks in the response should be found. Each coil should be tuned to its inner peak or the slug position of each coil should be away from the printed circuit board. Use the non-metallic tuning tool, part of the NLN6634A Tuning Tool Kit, for tuning L2, L3 and L4.

e. Selective Call Circuitry Analysis

In addition to the theory of operation section and the typical reed circuitry measurement chart, the following information is provided to aid in locating a malfunction in the selective call (paging) circuitry

If the 20 dB quieting sensitivity is within the given specification but the paging circuit sensitivity is not, a malfunction of a "Vibrasponder" resonant reed and/or its associated circuitry will be the cause. If the voltage required for the 20 dB quieting sensitivity check is greater than specified, the paging circuit sensitivity also will be degraded. If this condition exists, check the rf and i-f circuitry as outlined in the MAINTENANCE section of this manual.

The reed circuitry may be checked by following the procedure outlined in paragraph 2. b. (4), Paging Check.

If the reed outputs are within the specified limits and the remainder of the selective call circuitry is operating as described in the theory of operation section, the paging sensitivity should be satisfactory.

The level of "Vibrasponder" reed output required to trigger the 1st trigger circuit (Q18 and Q19) may be checked by reducing the tone deviation until the voltage at the collector of Q19 drops to zero. The voltage at the "Vibrasponder" reed output should be approximately -43.0 dBm as read on an ac voltmeter.

"Vibrasponder" reed B, reed amplifier Q11 and the trigger circuit (consisting of Q12 and Q13) may also be checked as noted above. However, the clamp transistor (Q14) must be de-activated

by temporarily shorting its base to ground. A tone level of -43.0 dbm at the output of the "Vibrasponder" reed should be sufficient to trigger the 2nd trigger circuit (Q12 and Q13) and activate the tone oscillator, Q16. The alerting tone should be heard in the speaker at this time. If the tone is not heard when the collector of Q13 goes positive, check the tone oscillator stage, the reset-listen switch and the audio stages for malfunction.

If the pager gives a false alert tone, due to a mechanical shock or other causes, the clamp transistor (Q14) or the multivibrator stage (Q20 and Q21) is most likely the cause. The operation of these stages should be checked as described in the theory of operation section.

4. DISASSEMBLY PROCEDURE

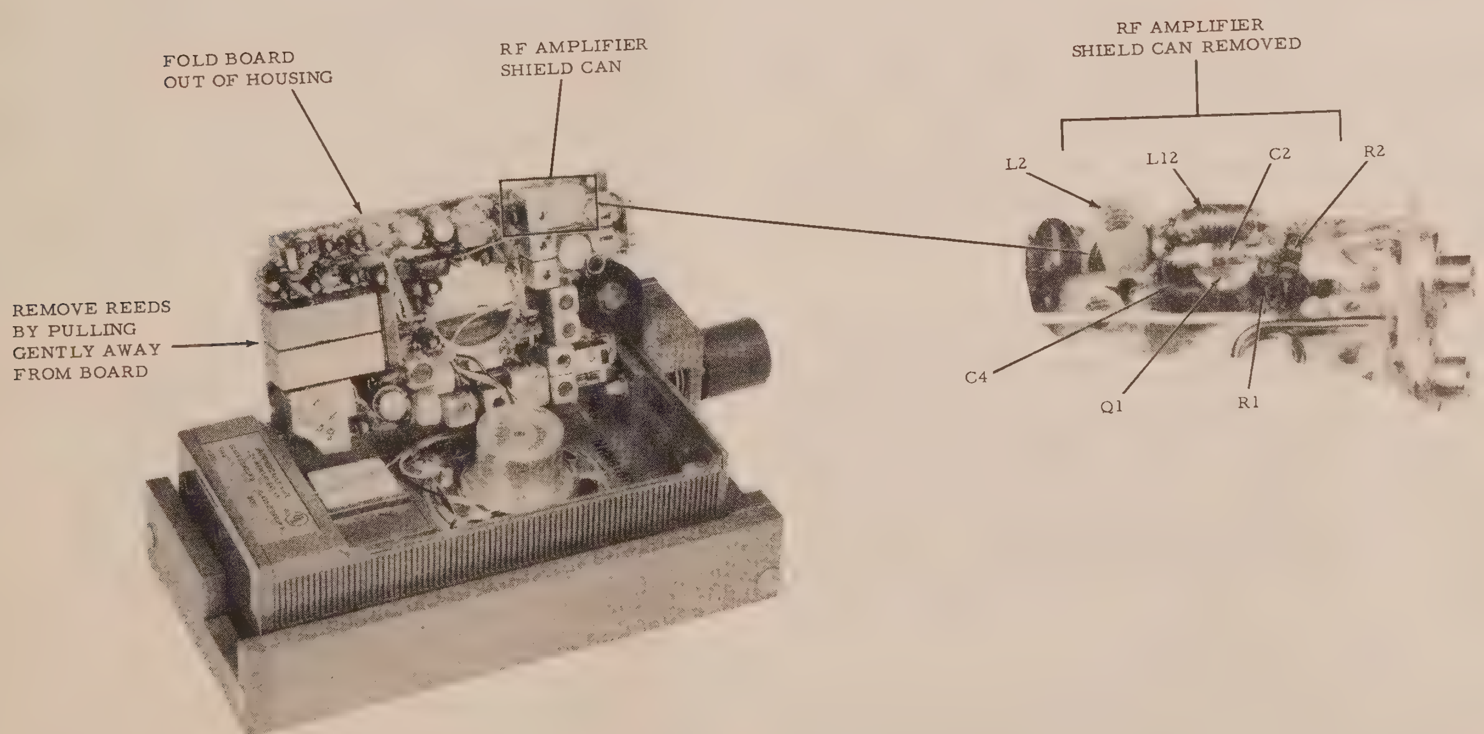
The "Pageboy" receiver is constructed on a single printed circuit board. The printed circuit board is attached to the housing by three wires. To remove the printed circuit board, remove the four screws holding the back cover and remove the back cover. Hold the radio in one hand and tap it to loosen the board from the housing. DO NOT pry the board away from the housing. To remove the "Vibrasponder" resonant reeds, fold up the printed circuit board in the housing as indicated on the Disassembly Procedure and gently pull the reeds away from the board.

Should the receiver become inoperative and repair necessitates the removal of some components, the considerations described in paragraph 5. REPAIR TECHNIQUES should be consulted before parts removal is attempted. If it is necessary to remove the rf amplifier transistor, Q1, a special procedure must be followed. Remove the shield can as illustrated on the Disassembly Procedure photo. The arrangement of parts in the rf amplifier is shown in the enlarged section of the rf amplifier shown on the Disassembly Procedure photo. The arrangement of C2, L12, R1 and C4 is critical to the neutralization of the rf amplifier. To remove the rf transistor, Q1, unsolder the junction of C2 to R1 and carefully move C2 aside. Then unsolder L12 from coil L2 and pivot L12 up. This should make Q1 accessable from the top. On replacing Q1, be sure that L12 and C2 are positioned as shown. Check to see that the position of C4 or the solder connection between C4 and L2 has not been altered.

NOTE

R1 and L12 are not used in the following receiver boards:

KIT NO.	SUFFIX
NRE6022AB	9 & Later
NRE6032AB	10 & Later
NRE6043AA	4 & Later
NRE6044AA	4 & Later



Disassembly Procedure

5. REPAIR TECHNIQUES

a. Construction

All components used in this pager are mounted on a printed circuit board. This board is the etched copper type with special eyelets in all component mounting holes. This type of board is far superior to the metal foil plated type due to the binding properties of the copper plating to the glass epoxy board. In addition, the special eyelets used in the component mounting holes act as mechanical strain relief members, thereby removing strain from the actual printed circuit.

Early printed circuit board repair techniques stressed the use of low wattage soldering tools to prevent board damage when components were removed. Experience has shown that the low wattage iron may actually cause printed circuit damage. A considerable amount of time is usually required to heat a connection to the melting point with a low wattage iron. During this time, heat is conducted away from the connection along the printed wiring. This conducted heat may separate the printed wiring from the board or damage nearbysolder connections. A medium wattage soldering iron (approximately 50 watts) is recommended for printed circuit repair. This iron should have a temperature controlled tip to prevent excessive heating and increase tip life. The ST-1087 soldering iron, with an 800 degree tip, is an excellent choice for printed circuit work. This unit is shown in Figure 8.

Clearing circuit board holes of excess solder with a pick, as formerly recommended for some Motorola products, has been shown to cause damage to the plating in and around the hole when excessive zeal is used in applying this technique. In order to prevent this occurrence, it is recommended that holes be cleared only by solder extraction. The ST-1091 Solder Remover may be used to extract molten solder.

Breaks in the printed circuit wiring can be repaired by bridging the gap with solder. Remove the resin coating covering the printed wiring with solvent before soldering. Areas of damaged circuitry that cannot be practically repaired with a solder bridge can be replaced with a piece of hook-up wire. The hook-up wire should be routed along the original path of the printed circuit to avoid any lead dressing problems in critical areas.

b. Component Removal

The various components are arranged in "decks," or layers, with those least susceptible to failure on the lower level. At times, however, it may be necessary to remove other components in order to service the faulty one. Special care should be taken during troubleshooting to be as certain as possible that the suspected component is the faulty one. This special care will eliminate unnecessary unsoldering and removal of parts which may weaken or damage the eyelet board.

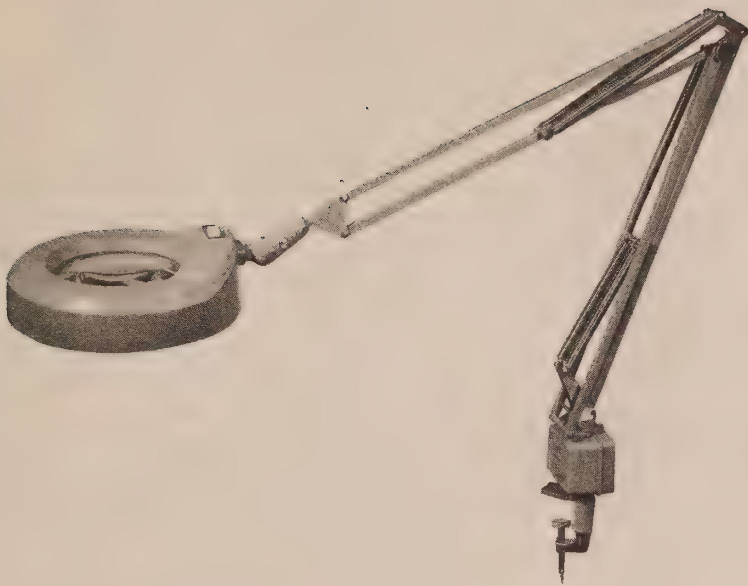
For removal and replacement of resistors, capacitors, etc., a holder such as the ST-458 Circuit Board Holder, or equivalent, is recommended to allow the use of both hands and to provide easy access to components. Mount the circuit board in the holder and rotate the board to a convenient position. Gently grasp the component lead with a "seizer" (Motorola ST-207) or needle-nose pliers. Heat the solder connection until molten, and remove the lead from the board. Do not apply the soldering iron any longer than necessary to free the lead. After the component has been removed, prepare the board for the replacement component by extracting all solder from the component mounting holes. Use resin solvent and a small brush to clean this portion of the printed circuit after the excess solder has been removed. Use the leads of the defective component as a model to form the leads of the replacement. Remove insulators and spacers on the defective component and install these on the replacement component. Insert the new component with a slight bend on the leads at the board to prevent movement while soldering. Heat the lead and the printed circuit at the connection pad with a clean, hot, well tinned iron. Apply solder in moderation. Use only enough to fill the hole, coat the pad, and provide a slight fillet around the component lead. Immediately remove the solder and iron when this has been accomplished. Allow time for solidification before proceeding. Do not disturb the component while the connection is cooling. After the solder has solidified, clip the lead as close to the board as possible. Clean away residue with resin solvent and a small brush. The finished connection should have a bright, mirror-like appearance.

c. Servicing Aids

Motorola has available several items which can be used to aid in parts replacement and repair of the printed circuit board.

(1) Magnifying Glass

Miniaturization requires precision work both in manufacture and in field service. Adequate concentration of light and magnification enable a more detailed visual examination of connections and miniature parts. The ST-652 or ST-650 Magnifying Glass & Built-In Light Source are most satisfactory devices for use in servicing



ST-650 Magnifying Glass & Built-In Light Source

miniature equipment in the shop. The large illuminated magnifying glass makes it easy to see any portion of the small components found on the printed circuit board. Refer to the accompanying illustration.

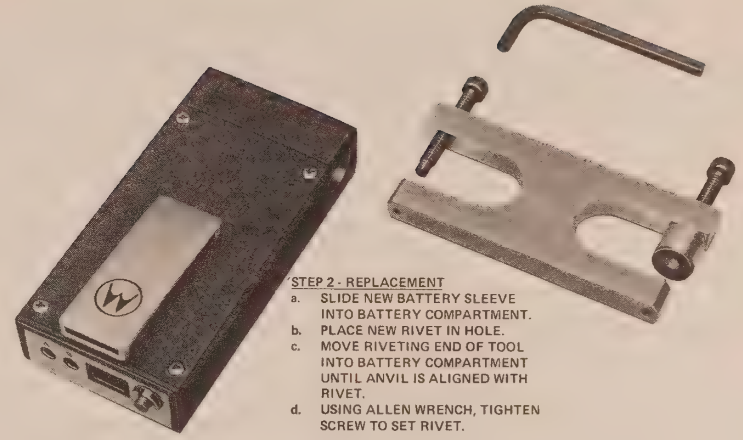
(2) Battery Sleeve Riveting Tool

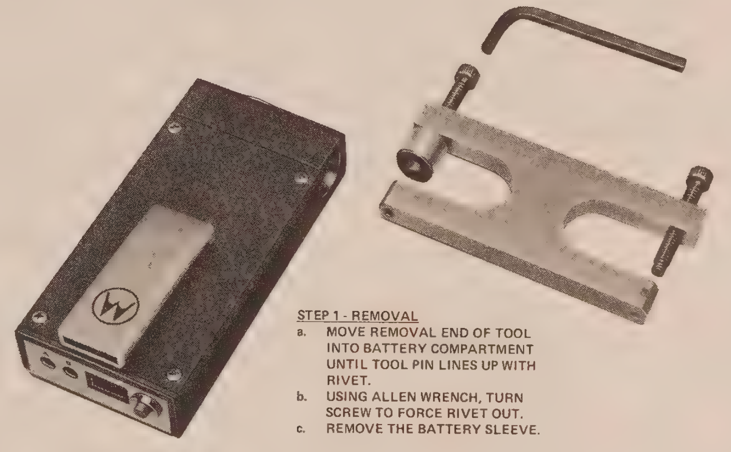
The battery sleeve (Part Number 43C84295H01) is secured in the housing with two rivets. Use tool Part Number 557706 to remove the rivets and to install new rivets, when replacing the battery sleeve. Refer to the accompanying illustration.

(3) Repair of RTV Coil Forms

RTV coil forms that have developed loose core torque due to peeling or insufficient RTV can be repaired, using the following procedure:

ST-1087 Soldering Iron





Battery Sleeve Riveting Tool Application

(a) Material Required

1. Dow Corning Silastic 732 RTV - Motorola Number ST-672.

2. Small, round soft bristle wire brush same size as inside diameter of coil form. Obtain locally.

3. Carbon Metrachloride - Obtain from local electronics supplier.

(b) Procedure

1. Remove the tuning core and brush out all loose RTV with wire brush. Blow all loose particles out with an air hose.

2. Apply a small amount (about the size of a match head) of fresh RTV to the inside of the coil form.

3. Insert the coil core in the coil form and, using a tuning tool, run the core through the form until the core protrudes from the opposite end of the form.

4. Clean off excess RTV from both ends of the coil form using a small cloth dipped in Carbon Metrachloride. Make sure the slot in the core is free of RTV.

5. Run the core back to the required peak of the coil.

6. Air cure at room temperature for 8 hours or longer.

7. Repeak the coil if necessary.

8. Repeat the procedure if the core still does not have the required torque, eliminating step 1.

d. Alignment Notes

When replacing crystals, realign the pager as described in the alignment procedure in this manual. Also, if any component in a trouble stage is replaced, realign the associated, the preceding, and the following stages.

The 20 dB quieting and paging circuit sensitivity measurements are good checks of overall performance after repair work has been performed. These checks assure that the pager is working properly.

6. AUDIO AND REED AMPLIFIER MEASUREMENTS CHARTS

Chart A

FREQUENCY	MEASUREMENT POINT	READING
1000 Hz	M-3 ORG	-12 dbm (0.20 v)
	Base of Q7 (Note 3)	-24 dbm (0.05 v)
	Collector of Q7	-1 dbm (0.70 v)
	Base of Q8	-45 dbm (0.0045 v)
	Collector of Q8	+1 dbm (0.88 v)
	Bases of Q9 & Q10	+1 dbm (0.88 v)
	Speaker (M-5 GRN)	-5 dbm (0.44 v)

Chart B

FREQUENCY	MEASUREMENT POINT	READING (NOTE 5)
TONE A OR B	M-3 ORG	-10 dbm (0.25 v)
TONE A OR B	Base of Q6	-10 dbm (0.25 v)
TONE A OR B	Emitter of Q6	-15 dbm (0.14 v)
TONE A	Base of Q17	-30 dbm (0.025 v)
TONE A	Collector of Q17	+2 dbm (1.0 v)
TONE B	Base of Q11*	-30 dbm (0.025 v)
TONE B	Collector of Q11*	+1 dbm (0.88 v)
TONE B	Speaker (M-5 GRN)**	+5 dbm (1.4 v)

*Clamp stage disabled by temporarily shorting base of transistor Q14 to ground. The alerting tone will be heard.

**Clamp stage disabled (see previous paragraph). Jumper JU1 connected for maximum alert tone output, or volume control set for maximum output.

NOTES

1. Connect the signal generator to the antenna jack, J1.
2. Modulate the signal generator with a 1000 Hz tone adjusted for 3.3 kHz deviation. Tune the generator to the carrier frequency (zero reading on test point M-3) and set the signal level into the receiver to 1000 microvolts.
3. Turn the audio on and, using a Motorola solid-state ac voltmeter (or equivalent), adjust the volume control for a reading of -5.0 dBm at meter point M-5 GREEN.
4. The readings listed in Chart A are referenced to ground an taken with a Motorola solid-state ac voltmeter (or equivalent) using an external power supply of 3.9 volts dc. The readings will be the same if a "fresh" battery is used.
5. The readings given in Chart B are obtained by modulating the signal generator at the proper reed frequency at 3.3 kHz deviation. The readings are taken with a Motorola solid-state ac voltmeter and are referenced to ground with the audio off. A "fresh" mercury battery is used for these readings.

7. RF AND I-F STAGE MEASUREMENTS

MEASUREMENT NO.	MICROVOLTS TO J1	METER POINT	READINGS IN MILLIVOLTS (UNLESS OTHERWISE NOTED)		
			S1339A	S1053C	S1063B
1	Noise	Base Q4	2.7 V		2.7 V
2	Noise	Emitter Q4	1.8 V		1.8 V
3	Noise	Base Q3	110		80
4	Noise	Base Q2	30		5
5	5000	Collector Q1	14		
6	20,000	Base Q2	45		10
7	5000	Collector Q2	250 (350)		140 (300)
8	500	Collector Q3	550	-7.0 dbm	520
9	500	IC1 Pin 1	40	-25.0 dbm	20
10	1.01	M-2 RED	45	-27 dbm	26
11	Noise	M-2 RED	4.0	-50 dbm	

NOTES: 1. All measurements made at a supply voltage of +3.7 V dc.
2. Use two 0.29 uH chokes in series with the leads of the ac voltmeter for measurements 9, 10, and 11.

a. Connect the signal generator to the external antenna jack, J1. Use a 6 dB pad on the generator and couple the pad output to the receiver with an rf adapter cable (Motorola part number 30-84875H01). Avoid using a spliced cable or multiple cables in series which will increase the SWR.

b. Adjust the signal generator to the carrier frequency.

c. Readings are given for three types of voltmeters:

(1) Motorola RF Millivoltmeter (S1399A)
(2) Motorola Solid-State AC Voltmeter (S1053C).
(3) Motorola Solid-State DC Multimeter with RF Probe (S1063B)

d. For a signal input designated "noise" in the chart, turn the signal generator off carrier frequency.

e. The readings provided are termed "typical" for a properly aligned receiver, that is, a 20% variation around the value given is usually tolerable. An inoperative stage is usually indicated by a measurement that is half (or less) the typical value provided.

f. Measurements 1 through 4 are a measure of the oscillator activity and the subsequent high and low frequency injections. Loss of oscillator output as indicated in measurements 1 and 2 or any of the injections as indicated by measurements 3 and 4 will cause the radio to be inoperative.

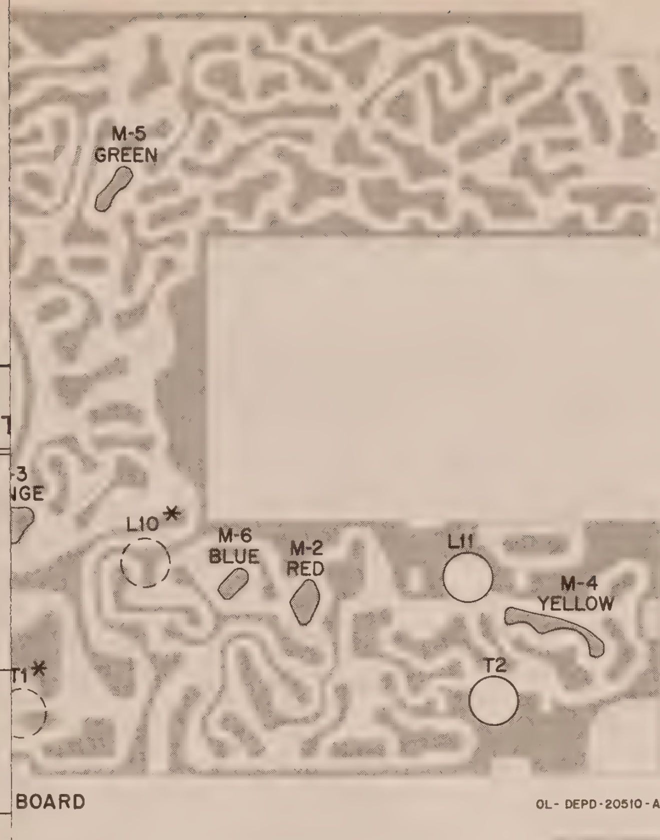
g. Measurements 5 through 10 are dependent upon the signal level from the signal generator. A reasonable degree of confidence should be established that the level set on the signal generator attenuator is obtained at the output of the 6 dB pad. Setting the generator output to the set level line on the meter does not necessarily assure that the output voltage is given by the attenuator unless the signal generator has been calibrated recently. Changing the signal generator output voltage should change these measurements by a proportional amount.

h. Measurement 11 indicates the typical noise level monitored at M-2. This noise level is the sum of two components, the residual noise of the i-f amplifier and the front end noise coupled through the 455 kHz filter. The i-f amplifier residual noise can be measured by placing a short across terminals 1 and 4 of the 455 kHz filter input transformer T1 thereby eliminating the front end noise component. The M-2 noise level should then drop to about -65.0 dBm.

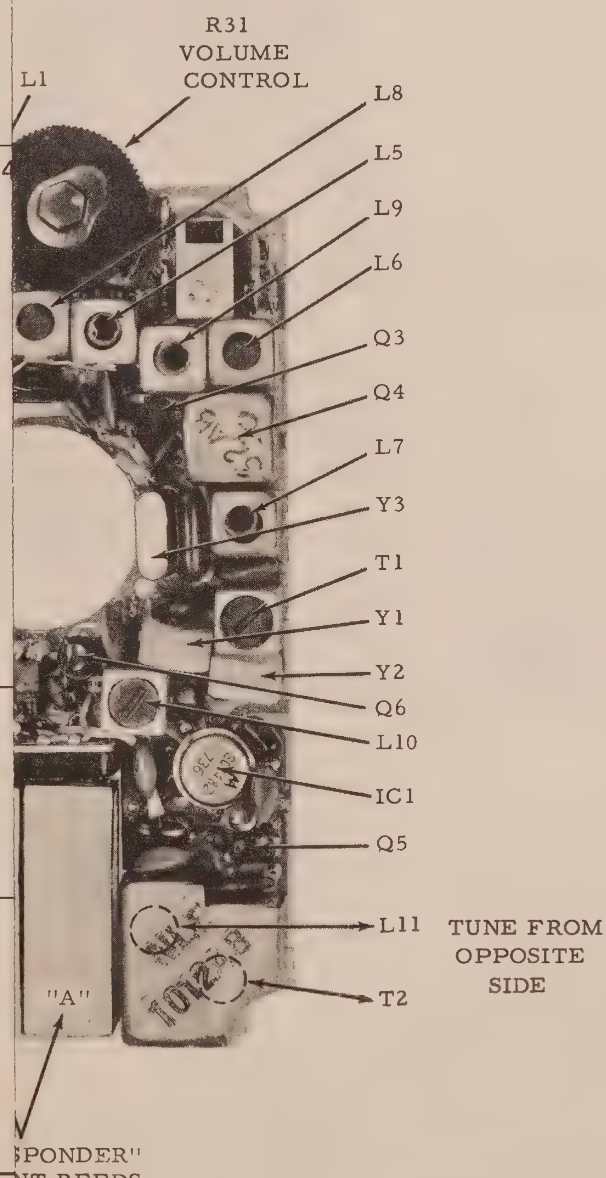
i. All measurements are made between the meter point specified and the nearest ground point. The probe ground for both the S1339A and the S1053C should be as short as possible and should connect to the ground that is directly involved with the circuit being measured.

j. Measurements 4, 5, 6, and 7 are each made across a variable inductance and can be changed by varying L6, L2, L4 and L8 respectively. However, L6, L2, and L4 do not have sufficient tuning range to be able to compensate for the capacitance added by the voltmeter probed. L8 does have enough tuning range and the measurement that is obtained after L8 is retuned with the meter probe on the first mixer collector is in parenthesis.

STEP	TEST EQUIPMENT	METER POINT & COLOR CODE	ADJUSTMENT
1	455 kHz signal generator, ac voltmeter	M2 Red	T1, L10
2	High impedance dc voltmeter, 455 kHz signal source	M4 Yellow	T2 (Limiter)
3	High impedance dc voltmeter, 455 kHz signal source	M3 Orange	L11 (Discriminator
4	High impedance dc voltmeter	M1 Brown	L5, L6
5	Signal generator and counter, or service monitor, high impedance ac voltmeter	M2 Red	C1, L2, L3, L4 L8, L9, L5 & L6
6	High impedance dc voltmeter, service monitor, or signal generator and counter.	M3 Orange	L7
7	Signal generator, adapter cable, ac voltmeter		

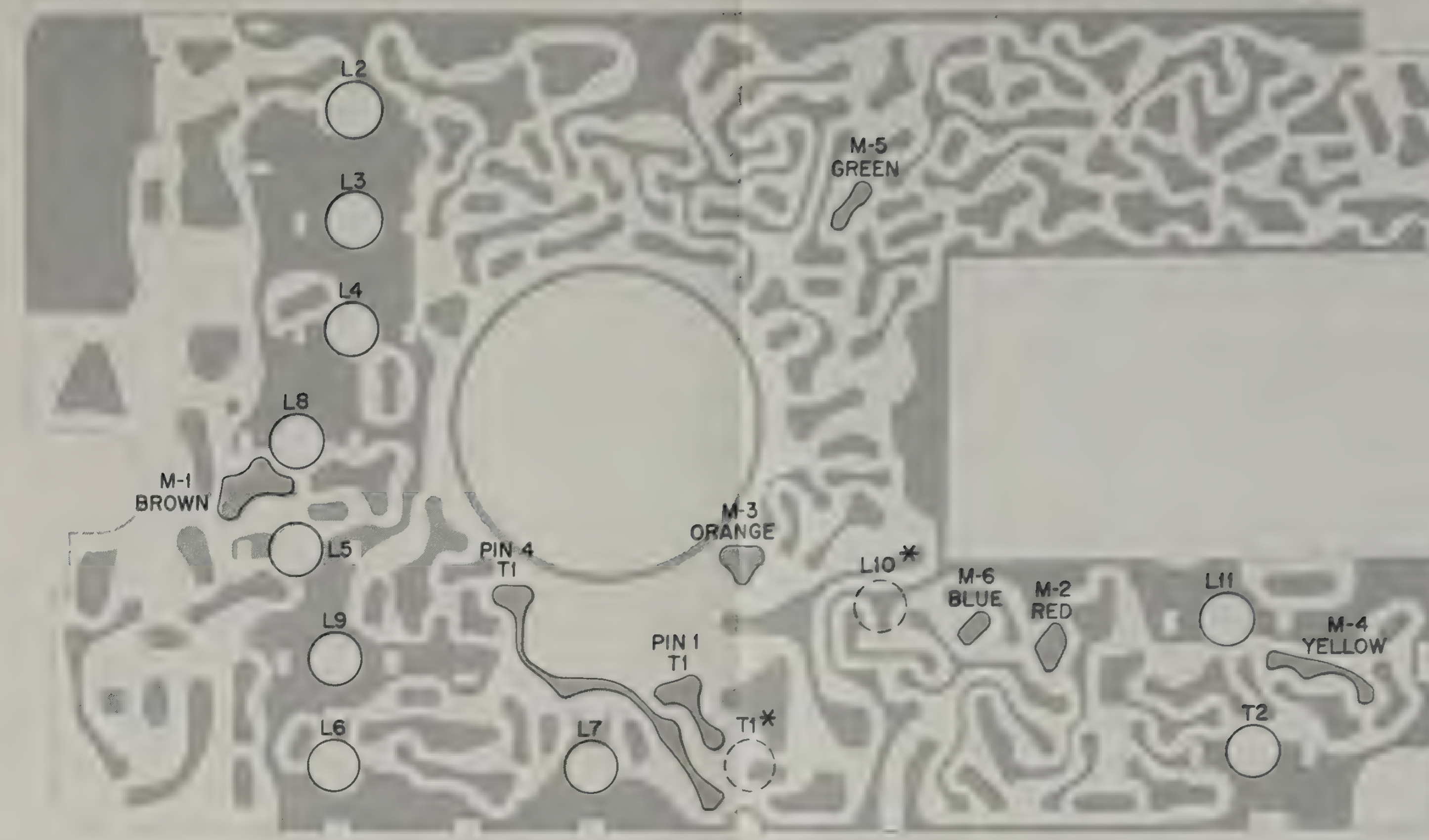


ignment Points



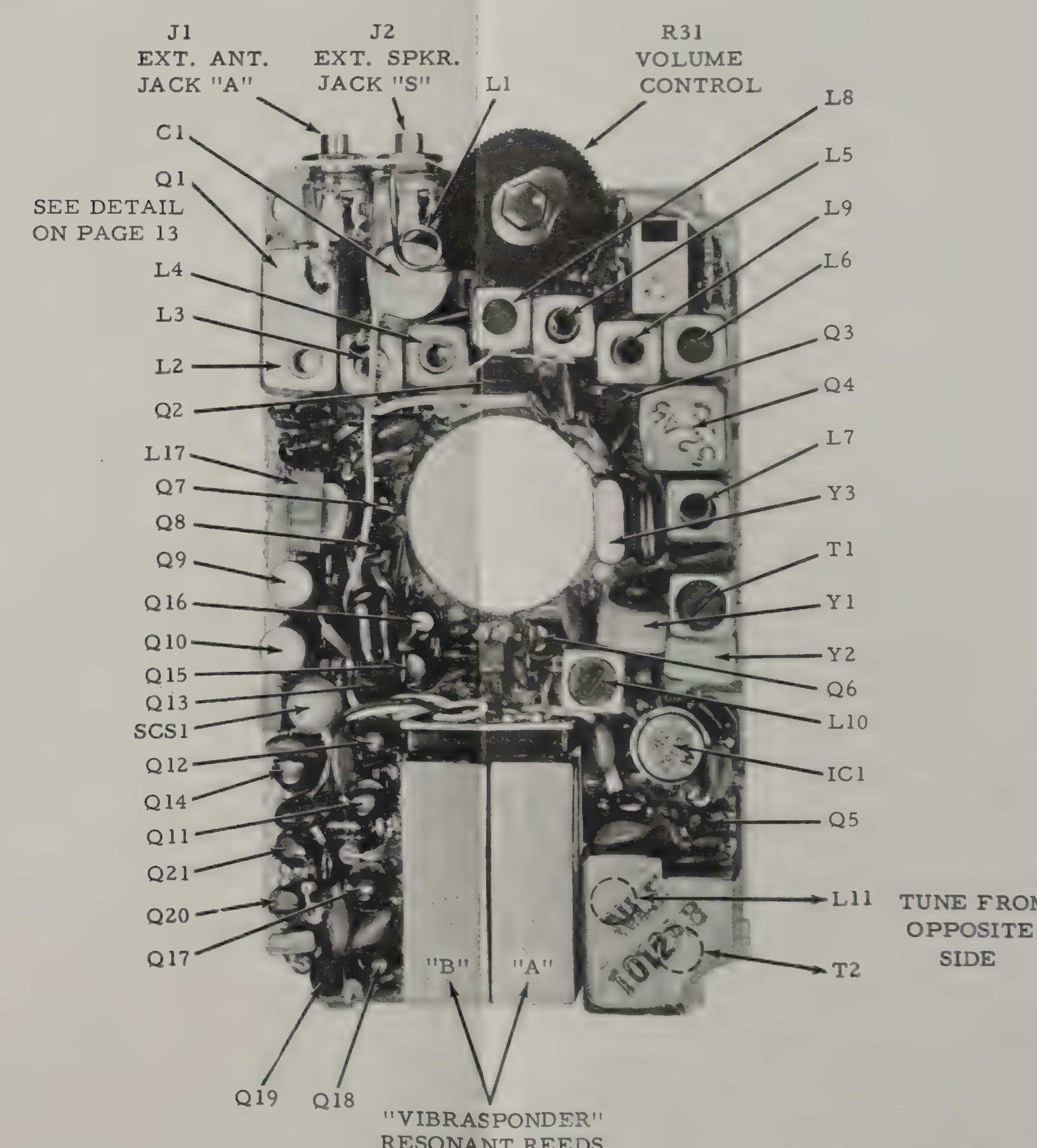
ALIGNMENT PROCEDURE

STEP	TEST EQUIPMENT	METER POINT & COLOR CODE	ADJUSTMENT	PROCEDURE
1	455 kHz signal generator, ac voltmeter	M2 Red	T1, L10	Capacitively couple a 455 kHz signal to the base of Q3. Connect the ac voltmeter to test point M2 and ground using two .29 uH chokes in series with the leads. Adjust T1 and L10 for peak meter reading. Adjust level of incoming 455 kHz signal as required to keep meter reading below -30 dBm. Retune T1 and L10 several times to assure peak reading. Use a wide blade tuning tool when tuning T1 and L10.
2	High impedance dc voltmeter, 455 kHz signal source	M4 Yellow	T2 (Limiter)	Connect a 455 kHz signal to meter point M2 (red). Monitor voltage at meter point M4 (yellow) and adjust T2 for maximum negative reading which should be at least -1.8 volts.
3	High impedance dc voltmeter, 455 kHz signal source	M3 Orange	L11 (Discriminator)	With 455 kHz signal still coupled to M2, monitor voltage at M3 (orange) and adjust L11 for zero reading. Repeat steps 2 and 3 and then remove 455 kHz signal from M2.
4	High impedance dc voltmeter	M1 Brown	L5, L6	Monitor voltage at M1 metering point. Without injection, voltage should be about +1.6 V dc. Adjust L6 first for dip in this voltage and then adjust L5 for similar dip. With both multiplier coils, L5 and L6, properly tuned, voltage dip should be at least .2 V dc.
5	Signal generator and counter, or service monitor, high impedance ac voltmeter	M2 Red	C1, L2, L3, L4, L8, L9, L5 & L6	Connect generator to antenna jack (J1). Monitor voltage at meter point M2 (red) with ac voltmeter (using two .29 uH chokes in series with leads). Set output level of generator to about 10,000 microvolts and tune generator to carrier frequency (f_c) as indicated by discriminator zero (M3 voltage zero) being careful to avoid tuning to close-in spurious (if using the S1341A or S1342A Signal Generator) responses of f_c -227 kHz and f_c -910 kHz. With a large rf signal input, IC1 will saturate at about -21 dBm on the ac voltmeter at M2. Reduce signal generator level until i-f level is about -30 dBm. Adjust all coils, transformer, and capacitor in order given in "adjustment" column for a peak in i-f level, reducing generator level as necessary to maintain peak i-f level at about -30 dBm on the ac voltmeter. L2, L3, and L4 should be tuned with non-metallic tuning tool provided in the NLN6634A Tuning Tool Kit. There should be two definite peaks in L2, L3, and L4. These coils should be tuned to their inner peak or where slug position is furthest from printed circuit board.
6	High impedance dc voltmeter, service monitor, or signal generator and counter.	M3 Orange	L7	Using service monitor or a calibrated signal generator as a signal source, adjust L7 for zero reading at M3.
7	Signal generator, adapter cable, ac voltmeter			Connect audio adapter cable to external speaker jack (J2). With signal generator connected to external antenna jack (J1) but tuned away from carrier frequency, turn audio on and adjust volume control for an output noise level 0.55 V ac or -3 dBm. Adjust signal generator level until receiver output noise level is reduced by 20 dB. The signal generator level required to produce 20 dB of quieting is proportional to 20 dB quieting sensitivity of receiver, and should be less than 0.5 uV for a properly tuned receiver.

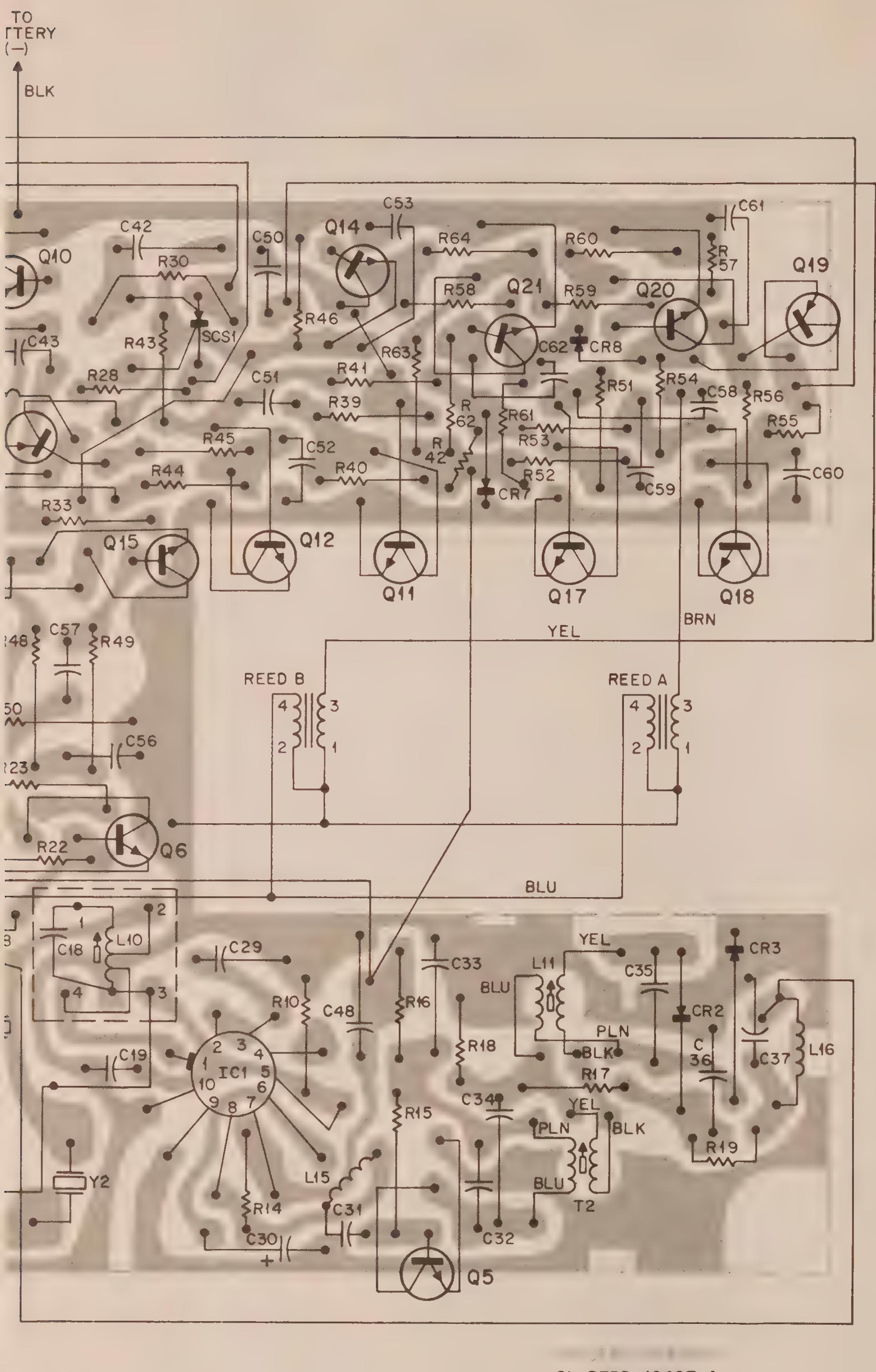


*T1 AND L10 TUNED FROM COMPONENT SIDE OF BOARD

Metering and Alignment Points



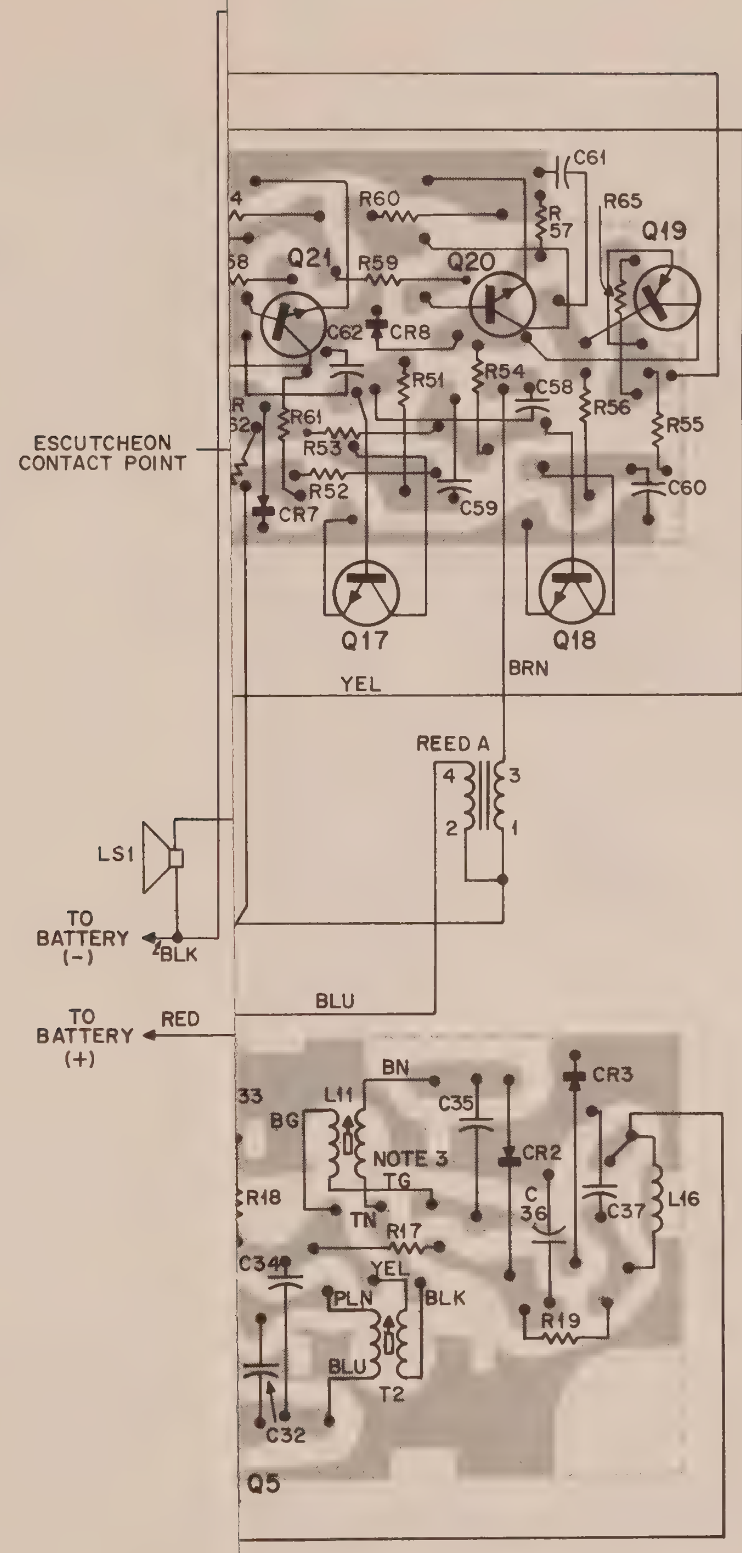
ALIGNMENT PROCEDURE



MODELS NRE6022AB AND
NRE6032AB WITH NO SUFFIX

EPF-5102-O

CIRCUIT BOARD AND WIRING DIAGRAM

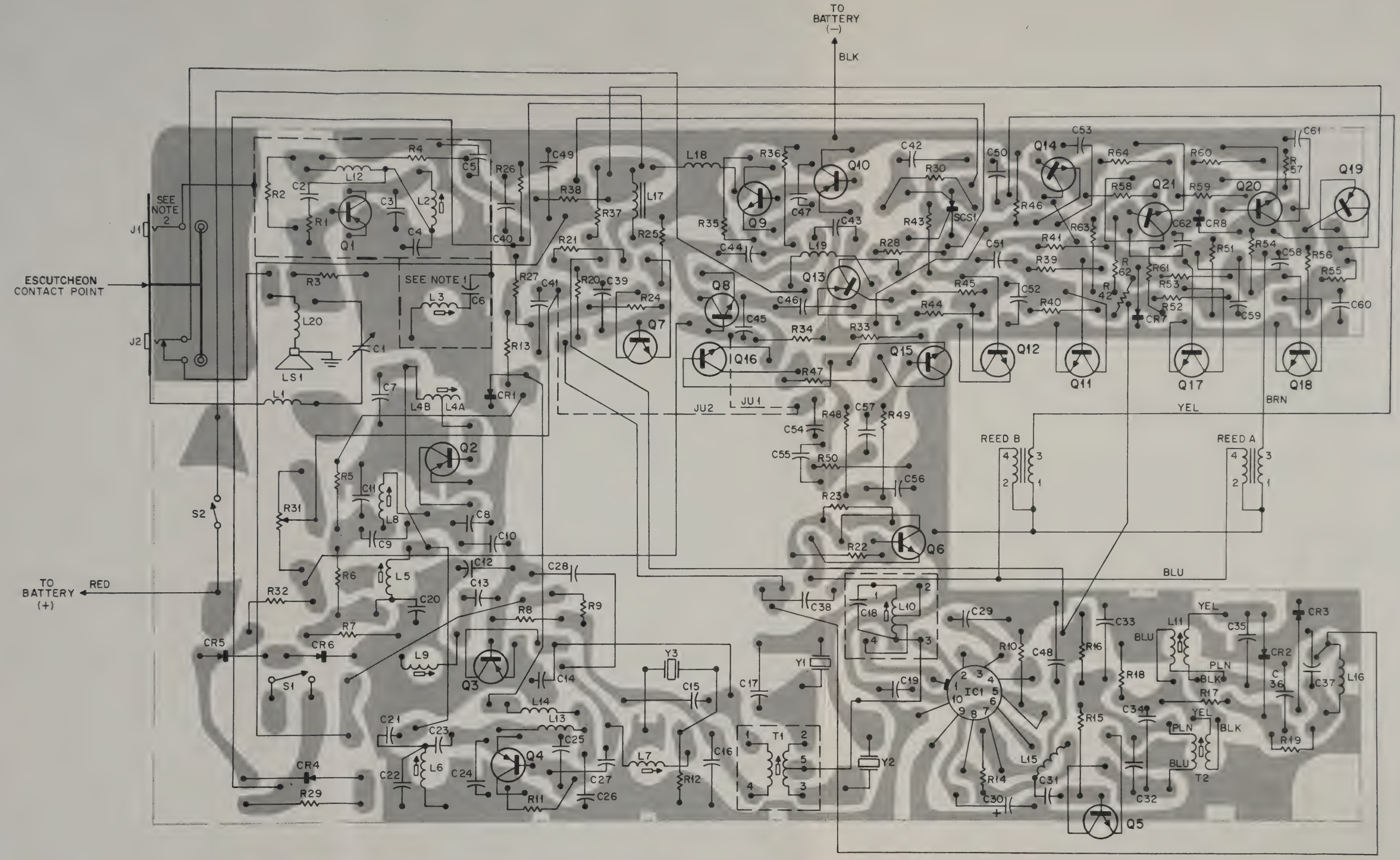


OL DEPD-20396-K

MODELS	
NRE6022AB-1	THRU -8
NRE6032AB-1	THRU -9
NRE6043AA	THRU -3
NRE6044AA	THRU -3

EPF-5103-O

CIRCUIT BOARD AND WIRING DIAGRAM



NOTES:

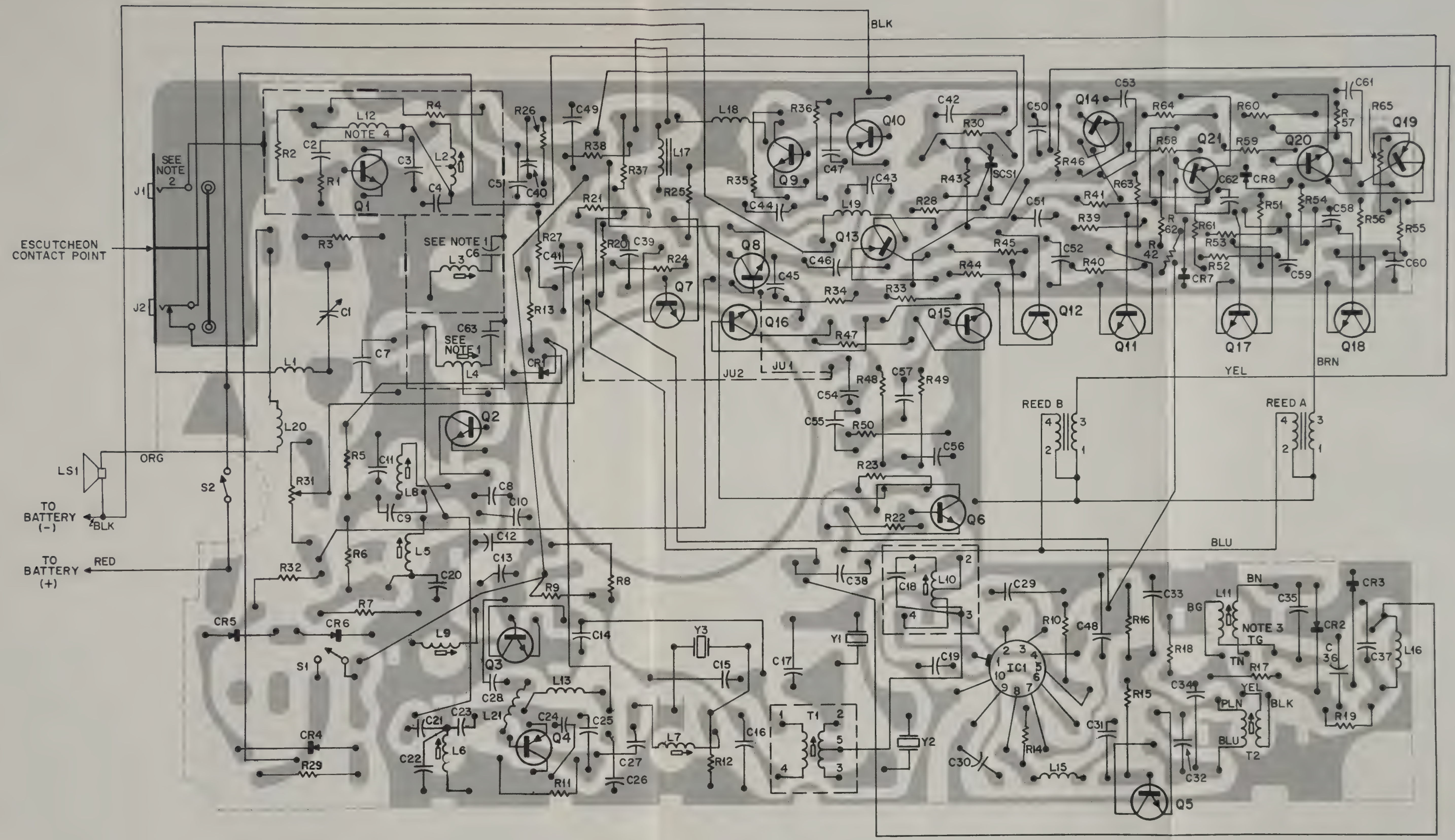
1. C6 GND POINT IS TOP OF L3 SHIELD CAN.
2. CONNECT J1 TO TOP OF RF SHIELD CAN.

8D-DEPD-19406-0
OL-DEPD-19407-A

MODELS NRE6022AB AND
NRE6032AB WITH NO SUFFIX

EPF-5102-O

CIRCUIT BOARD AND WIRING DIAGRAM



OL DEPD-20396-K

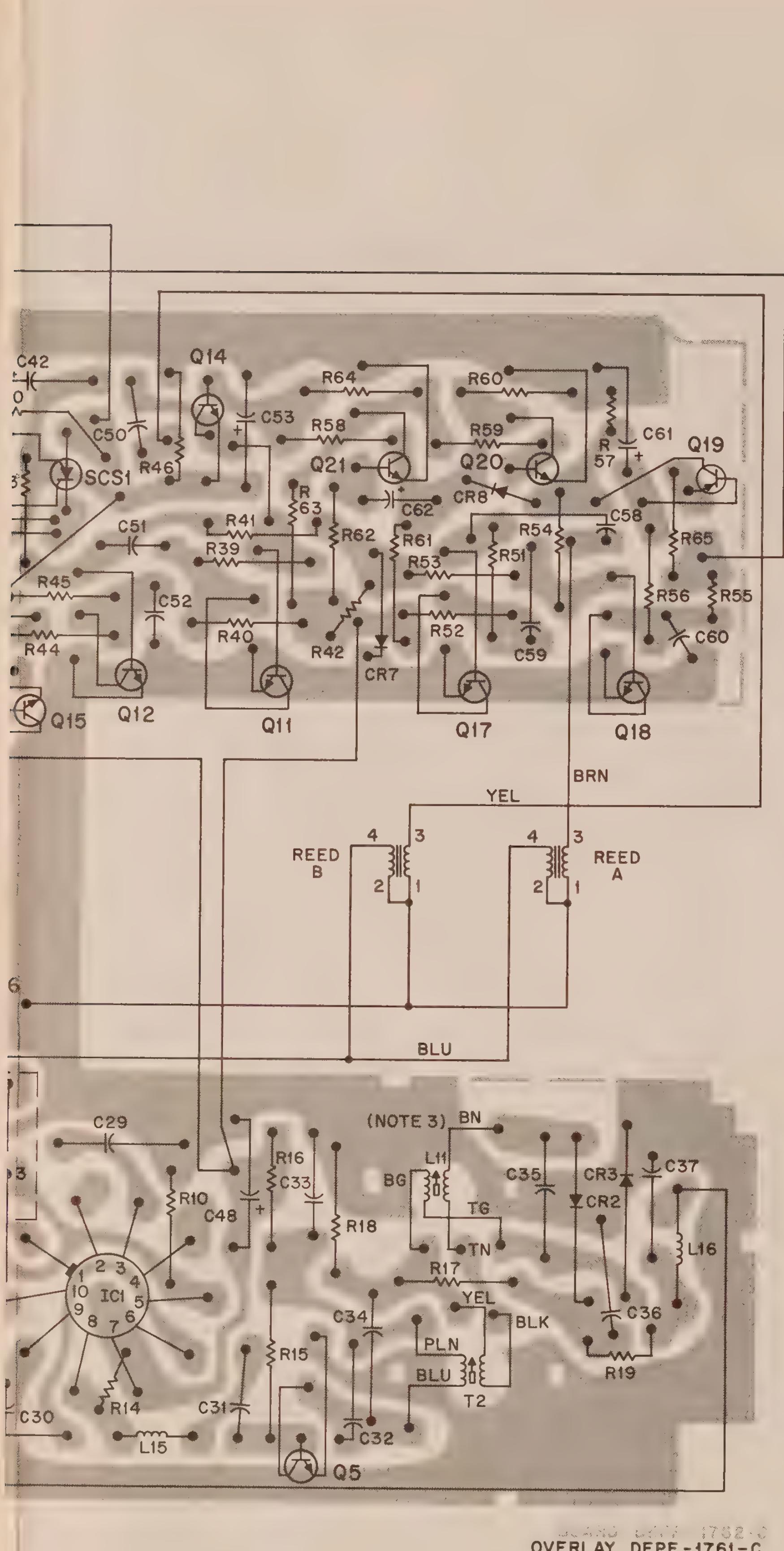
NOTES:

1. C6, C63 GND POINT IS TOP OF SHIELD CANS.
2. CONNECT J1 TO TOP OF RF SHIELD CAN.
3. TG = GRN WIRE ON TOP OF WINDING.
   BG = GRN WIRE ON BOTTOM OF WINDING.
   TN = NATURAL WIRE ON TOP OF WINDING.
   BN = NATURAL WIRE ON BOTTOM OF WINDING.
4. L12 IN 406-420 MHz MODELS ONLY. IN 456-470 MHz MODELS, C2-R4 IS CONNECTED TO L2 CENTER-TAP PER DASHED LINE.

MODELS	
NRE6022AB-1	THRU -8
NRE6032AB-1	THRU -9
NRE6043AA	THRU -3
NRE6044AA	THRU -3

EPF-5103-O

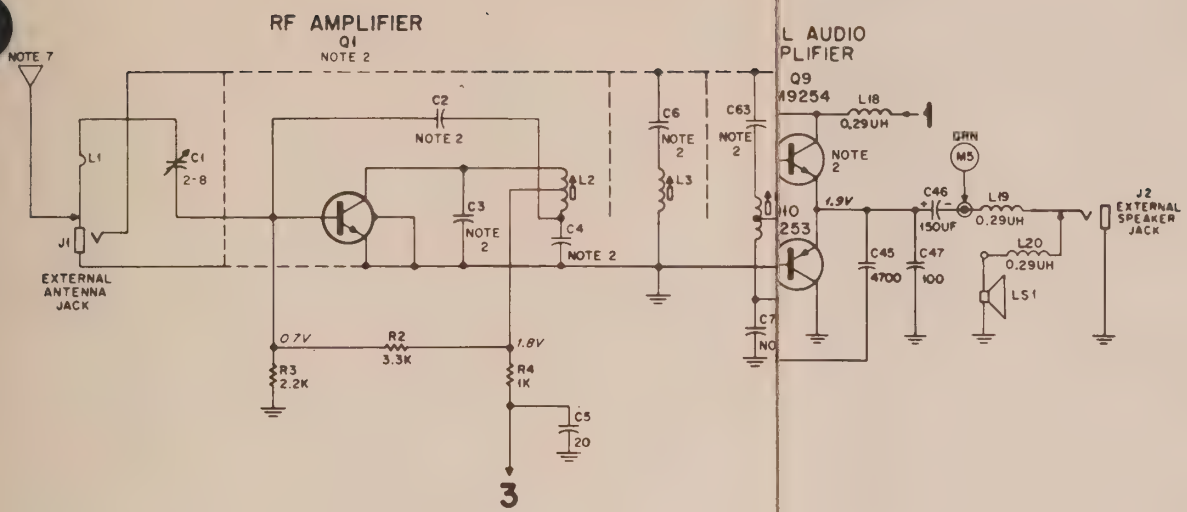
CIRCUIT BOARD AND WIRING DIAGRAM



MODELS
NRE6022AB -9 & LATER NRE6032AB -10 & LATER NRE6043AA -4 & LATER NRE6044AA -4 & LATER

EPF-5104-O

CIRCUIT BOARD AND WIRING DIAGRAM



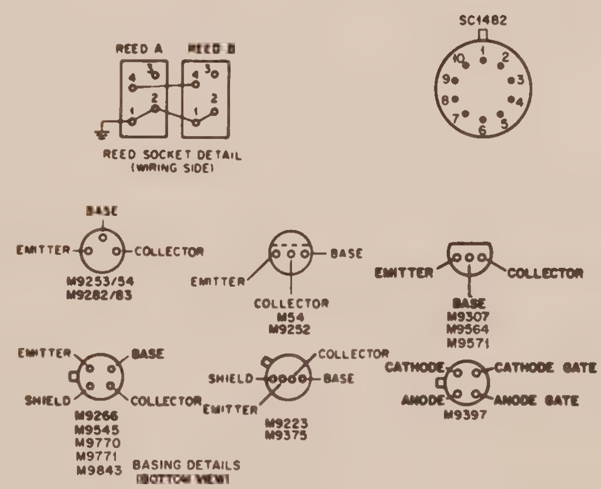


DIAGRAM NO. 63E81052A61-S

NOTES:

1. UNLESS OTHERWISE ST
   k = 1000; CAPACITOR
2. REFER TO PARTS LIST
3. THE ALERT TONE LEV
   CONNECTED. IT WILL
   CONTROL IF JU2 IS CON
4. "AUTOMATIC LISTEN"
5. 2.5-VOLTS - "AUTOMA
   3.4-VOLTS - PUSH-TO-
6. INPUT GROUND (PIN 10
   NOT BE CONNECTED T
7. THE ALUMINUM ESCUT
   ANTENNA FOR THE RE
   THE BRACKET FOR TH
   ANTENNA JACKS.
8. FREQUENCY CALCULA

$$F_o = \frac{F_c - .45}{25}$$

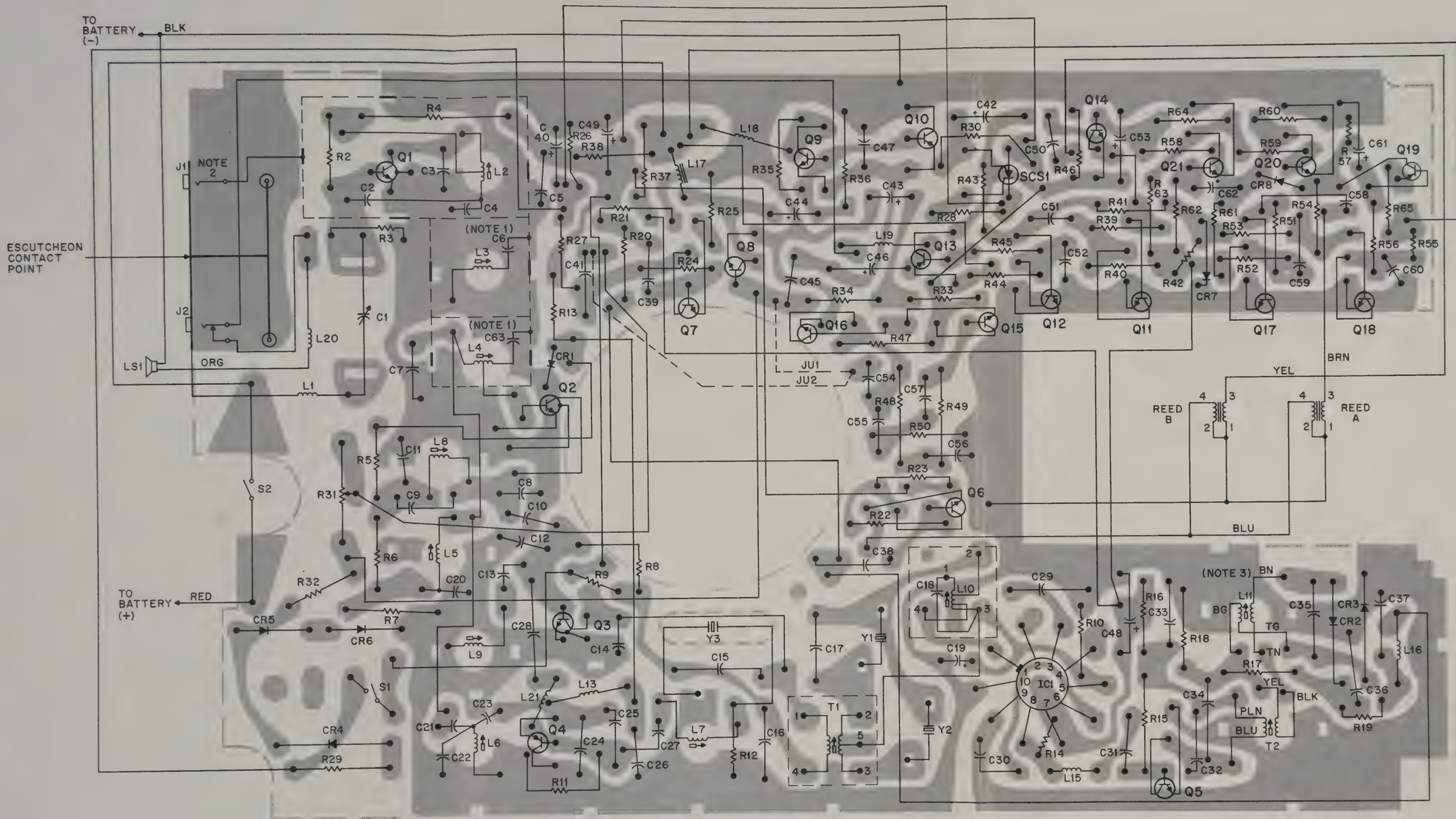
9. POSITIVE BATTERY CH
   AREA ON BATTERY CO
   INCLUDES SWITCH THA
   CADMIUM BATTERY IS
   CHARGING CONTACT IS
   SURFACE OF PAGER.
   PARTMENT COVER IS C
   TERMINAL OF BATTER
   FUNCTION.

VOLTAGE READING LEGEN

UNLESS OTHERWISE IN
READINGS ARE TAKEN
WITH NO RF SIGNAL AP

S = STANDBY CON
L = LISTEN COND
A = TONE "1" APP
B = TONE "2" APP
TONE "1".

SCHEMATIC DIAGRAM



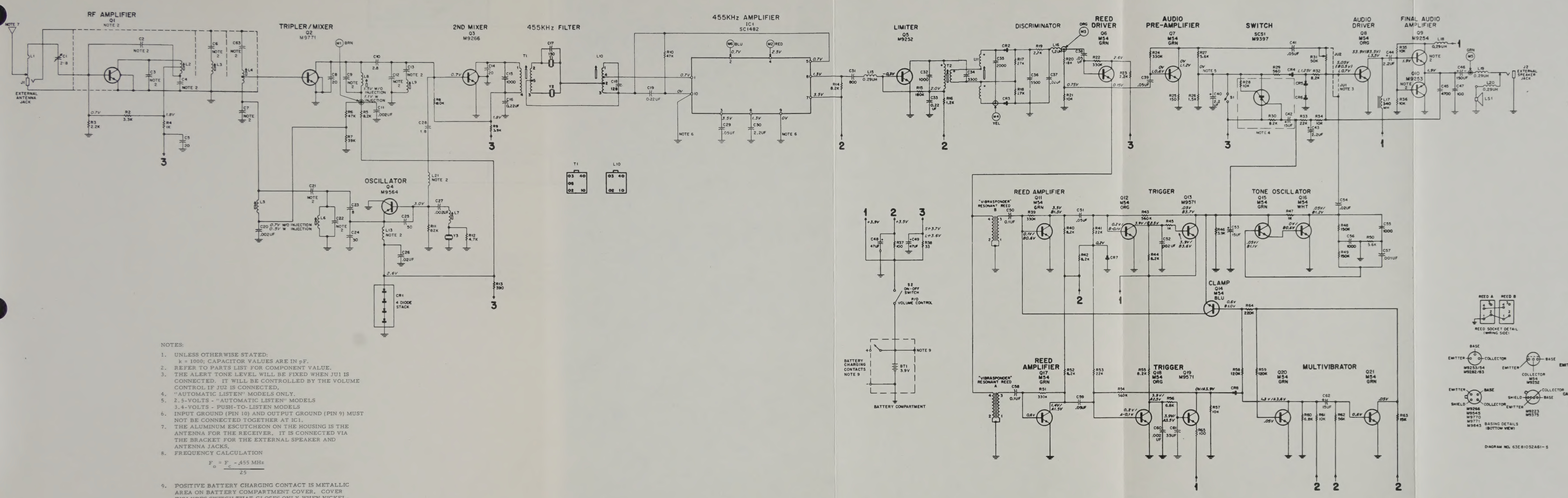
BOARD DEPF-1762-O
OVERLAY DEPF-1761-C

NOTES:
1. C6, C63 GND POINT IS TOP OF SHIELD CANS.
2. CONNECT J1 TO TOP OF RF SHIELD CAN.
3. TG= GRN WIRE ON TOP OF WINDING.
BG= GRN WIRE ON BOTTOM OF WINDING.
TN= NATURAL WIRE ON TOP OF WINDING.
BN= NATURAL WIRE ON BOTTOM OF WINDING.

MODELS
NRE6022AB -9 & LATER
NRE6032AB -10 & LATER
NRE6043AA -4 & LATER
NRE6044AA -4 & LATER

EPF-5104-O

CIRCUIT BOARD AND WIRING DIAGRAM



NOTES:

1. UNLESS OTHERWISE STATED:
   k = 1000; CAPACITOR VALUES ARE IN pF.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. THE ALERT TONE LEVEL WILL BE FIXED WHEN JU1 IS CONNECTED. IT WILL BE CONTROLLED BY THE VOLUME CONTROL IF JU2 IS CONNECTED.
4. "AUTOMATIC LISTEN" MODELS ONLY.
5. 2.5-VOLTS - "AUTOMATIC LISTEN" MODELS
   3.4-VOLTS - PUSH-TO-LISTEN MODELS
6. INPUT GROUND (PIN 10) AND OUTPUT GROUND (PIN 9) MUST NOT BE CONNECTED TOGETHER AT IC1.
7. THE ALUMINUM ESCUTCHEON ON THE HOUSING IS THE ANTENNA FOR THE RECEIVER. IT IS CONNECTED VIA THE BRACKET FOR THE EXTERNAL SPEAKER AND ANTENNA JACKS.
8. FREQUENCY CALCULATION

$$F_o = \frac{F_c - .455\ \text{MHz}}{25}$$

9. POSITIVE BATTERY CHARGING CONTACT IS METALLIC AREA ON BATTERY COMPARTMENT COVER. COVER INCLUDES SWITCH THAT CLOSES ONLY WHEN NICKEL-CADMIUM BATTERY IS USED. NEGATIVE BATTERY CHARGING CONTACT IS RIVET IN CENTER ON BOTTOM SURFACE OF PAGER. RIVET NEAR BATTERY COMPARTMENT COVER IS CONNECTED TO POSITIVE TERMINAL OF BATTERY BUT HAS NO ELECTRICAL FUNCTION.

VOLTAGE READING LEGEND

UNLESS OTHERWISE INDICATED, DC VOLTAGE READINGS ARE TAKEN WITH AUDIO OFF WITH NO RF SIGNAL APPLIED.

S = STANDBY CONDITION
L = LISTEN CONDITION
A = TONE "1" APPLIED TO REED DRIVER
B = TONE "2" APPLIED TO REED DRIVER AFTER TONE "1".

EPD-19361-D

MODEL TABLE

MODEL NO.	SUFFIX	DESCRIPTION
NRE6022AB	15	RECEIVER BOARD, 450-470 MHz "PUSH-TO-LISTEN"
NRE6043AA	8	RECEIVER BOARD, 406-420 MHz "PUSH-TO-LISTEN"
NRE6032AB	16	RECEIVER BOARD, 450-470 MHz, "AUTOMATIC-LISTEN"
NRE6044AA	8	RECEIVER BOARD, 406-420 MHz, "AUTOMATIC-LISTEN"
NHN6157A	1	HOUSING KIT

EPD-20902-G

SCHEMATIC DIAGRAM

REVISIONS

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE
NRE6022AB-1 NRE6032AB-1		CIRCUIT BOARD REDESIGNED
NRE6032AB-2	C42	WAS 23D82397D01 33 uF ±20%; 6 V
NRE6022AB-2 NRE6032AB-3	R65	ADDED
NRE6022AB-3 NRE6032AB-4	C12	WAS 21K861442, 70 pF
	C13	WAS 21K861431, 12 pF
NRE6022AB-4 NRE6032AB-5	L14	REMOVED (IN SERIES WITH AND BETWEEN L13 & CR1)
	L21	ADDED
	C28	RELOCATED
NRE6022AB-5 NRE6032AB-6	C63	ADDED
	Q2	WAS 48R869543 TYPE M9543
NRE6022AB-6 NRE6032AB-7	Q13, 19	WERE 48R869307 TYPE M9307
NRE6043AA-1 NRE6044AA-1	C6	WAS 21D82358G01 2.8 pF; 406-420 MHz
NRE6022AB-7 NRE6032AB-8 NRE6043AA-2 NRE6044AA-2	C28	WAS 21D82450B23
NRE6022AB-8 NRE6032AB-9 NRE6043AA-3 NRE6044AA-3	C7	WAS 15 pF
	C63	WAS 4.3 pF
	L4	REPLACED L4A (24D83744G04) AND L4B (24D83744G06)
	Q2	WAS 48R869606 TYPE M9606
NRE6022AB-9 NRE6032AB-10 NRE6043AA-4 NRE6044AA-4	L12	REMOVED, WAS 24D82723H11–Q1 AREA BETWEEN R4 AND JUNCTION OF C4 & C2
	R1	REMOVED, WAS 6S185B59– BETWEEN Q1 BASE AND C2
	Q1	WAS 48R869545 TYPE M9545
	C3	WAS 21D82877B17 5 pF; 406-420 MHz
	C4	WAS 21D82358G03 5.6 pF; 450-470 MHz WAS 21D82877B13 7 pF; 406-420 MHz
	L10	WAS 24D82559G13
NRE6022AB-10 NRE6032AB-11 NRE6043AA-5 NRE6044AA-5	R11	WAS 0600185C05, 120 k
NRE6022AB-11 NRE6032AB-12 NRE6043AA-6 NRE6044AA-6	C2	WAS 21D82450B38, 1.2 pF
	C4	WAS 21D82358G02, 4.8 pF
	C6	·WAS 48R869770, N-P-N; type M9770
NRE6022AB-12 NRE6032AB-13	C63	WAS 21D82877B08, 2.8 pF or 21D82877B09, 3.8 pF
	R11	WAS 0600185A95, 82 k ±5%
NRE6022AB-13 NRE6032AB-14 NRE6043AA-7 NRE6044AA-7	C3	WAS 21D82358G10, 2.1 pF
NRE6022AB-14 NRE6022AB-15	T2	WAS 2482678C08, TRANSFORMER
NRE6022AB-15 NRE6032AB-16 NRE6043AA-8 NRE6044AA-8		AS SHOWN

NRE6022AB ("PUSH-TO-LISTEN") 450-470 MHz
NRE6043AA ("PUSH-TO-LISTEN") 406-420 MHz
NRE6032AB ("AUTOMATIC LISTEN") 450-470 MHz
NRE6044AA ("AUTOMATIC LISTEN") 406-420 MHz

EPD-19695-H

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; ±10% 75 V; unl stated:
C1	20C82399D10	var; 2-8; 200 V; NPO
C2	21D82450B38	1.2 ±5% (406-420 MHz)
	or 2182450B51	1.5 ±5%; 500 V; (450-470 MHz)
C3	21D82358G84	1.7 ±0.1 pF; N150; 450-470 MHz
	or21D82358G01	3.3 ±0.25 pF; NPO; 406-420 MHz
C4	21D82358G03	5.6 ±0.25 pF; 50 V; NPO 450-470 MHz
	or 21K867807	8 ±5%; N080; 406-420 MHz
C5, 8, 14	21K861432	20; N150
C6	21D82358G10	2.1 ±0.1; N150; 450-470 MHz
	or21D82877B08	2.8 ±0.25; 50 V; NPO 406-420 MHz
C7	21D82358G61	13.5 ±5%; N150; 450-470 MHz
	or21D82877B46	18; N150; 406-420 MHz
C9	21D82358G14	65 ±5%; N080; 450-470 MHz
	or21D82877B32	80; NP0; 406-420 MHz
C10	21D82877B08	2.8 ±.25 pF; N150
C11,27,52,60	21K861442	.002 uF +100-20%
C12	21K864012	60; N150; 450-470 MHz
	or21D82358G14	65 ±5%; N080; 406-420 MHz
C13	21K861430	10; N150; 450-470 MHz
	or21K861431	12; N150; 406-420 MHz
C15	21C83374E01	1000 ±5%; 100 V
C16, 33	21K861478	0.22 uF; 200 V
C17	21D82428B50	150 ±5%; 200
C18		128; p/o L10
C19	23D83441B06	0.22 uF ±20%; 6 V
C20	21D82213E15	.002 uF +100-20%; 50 V
C21	21D82450B21	0.39; 500 V; 450-470 MHz
	or21D82450B22	0.75; 500 V; 406-420 MHz
C22	21K861431	12 ±10%; N150; 450-470 MHz
	or21K861462	15; 406-420 MHz
C23	21K861429	8; N150
C24	21K864521	30+30-10%; N750
C25	21D82358G15	50; 100 V; N3300
C26, 37, 54	21D83068E01	.02 uF ±20%; 12 V
C28	21D82450B49	1.8; 500 V
C29,38,39,41, 51, 59	21C82032D01	0.05 uF +80-20%; 10 V
C35	21D83162H07	0.002 uF; 50 V
C31	21K847070	800; 600 V
C34	21D82428B10	3300; 100 V
C36	21C82213E03	5500 +100-0%
C40,43,44,30	23D83441B04	2.2 uF ±20%; 6 V
C42	23D83397D13	15 uF ±20%; 6 V (NRE6032AB & NRE6044AA)
C45	21D82213E07	4700; 100 V
C46	23D83441B02	150 uF ±20%; 6 V
C47	21K861437	100
C48, 49	23D83441B01	47 uF ±20%; 6 V
C50, 58	21K864015	0.1 uF; GMV; 3 V
C53, 62	23D83441B03	15 uF ±20%; 6 V
C55, 56,57,32	21D82213E08	.001 uF ±5%; 50 V
C61	23D83397D12	33 uF ±20%; 6 V
C63	21D82877B43	2.5 ±0.25 pF, N150; 450-470 MHz
	or21D82358G01	3.3 ±0.25 pF; NPO; 406-420 MHz
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR1	48C83329G02	silicon
CR2, 3, 4, 8	48C82178A01	germanium
CR5, 6	48C83329G01	silicon
CR7	48C82178A06	germanium
		NETWORK, integrated:
IC1	51R83395E01	type SC1482
		CONNECTOR, receptacle:
J1, 2	9C82939C02	female; 2 cond; phone type
		COIL, RF:
L1	24B83684G01	1-1/4 turns
L2	24D83744G01	3-3/4 turns
L3	24D83744G02	4-1/8 turns
L4	24D83744G08	4 turns center tapped
L5	24D83744G07	3-1/4 turns
L6	24C83131B13	3-1/2 turns; coded YEL-WHT incl. 76K861425 CORE, tuning
L7	24D83131B12	37 turns; coded YEL-ORG, incl. 76B82451B09 CORE, tuning; 450-470 MHz
	or24D83131B16	37 turns; coded YEL-ORG, incl. 76B82451B04 CORE, tuning; 406-420 MHz
L8	24D83131B08	18 turns; coded RED-GRN, incl. 7605374B03 CORE, tuning
L9	24D83131B01	52 turns; coded YEL-BLU, incl. 76B82451B09 CORE, tuning
L10	24005834B01	4 pins; incl. ref part C18
L11	24D82678C07	coded RED-GRN; does not incl. 76K847159 CORE, tuning 37S10120A14 TUBING, mylar: heat shrink type; 0.44" length required
L13	24D82723H07	choke; 10 uh; 450-470 MHz
	or24D82723H01	choke; 1.2 uh; 406-420 MHz
L16	24D82723H01	choke; 1.2 uh
L15, 18, 19, 20, 21	24D82723H04	choke; 0.29 uh
L17	25B83564D02	choke; audio; 340 mh
		TRANSISTOR: (SEE NOTE I)
Q1	48R869770	N-P-N; type M9770 406-420 MHz
	or 48R869843	N-P-N; type M9843 450-470 MHz
Q2	48R869771	N-P-N; type M9771
Q3	48R869266	N-P-N; type M9266 (NOTE III)
Q4	48R869564	P-N-P; type M9564
Q5	48R869252	N-P-N; type M9552
Q6, 7, 11, 15, 17, 20, 21	48R134667	N-P-N; type M54 GRN
Q8, 12, 18	48R134665	N-P-N; type M54 ORG
Q9, 10	1V80753A04	matched pair; c/o:48R869254 TRANSISTOR: N-P-N; type M9254: (Q9) and 48R869253 TRANSISTOR: P-N-P; type M9253; (Q10)
	or1V80753A05	matched pair; c/o: 48R869283 TRANSISTOR: N-P-N; type M9283 (Q9) and 48K869282 TRANSISTOR: P-N-P; type M9282 (Q10)
Q13, 19	48R869571	P-N-P; type M9571
Q14	48R134673	N-P-N; type M54 BLU
Q16	48R134674	N-P-N; type M54 WHT
		RESISTOR, fixed: ±10%; 1/8 w
R2	6S185B85	3.3K
R3	6S185B83	2.2K
R4, 45	6S185B79	1K
R5, 14, 40, 42 44, 52	6S185B90	8.2K
R6, 10	6S185B99	47K
R7	6S185B98	39K
R8	6S185C07	180K
R9, 46	6S185B86	3.9K
R11	6S185C03	82K
R12	6S185B87	4.7K
R13	6S185B74	390
R15	6S129229	180K
R16	6S185B80	1.2K
R17, 18	6S185B96	27K
R19	6S128688	2.7K; 1/4 w
R20	6S185B94	18K
R36	6S129225	10K
R22	6S129228	330K; 1/4 w
R23	6S185B83	2.2K
R24, 39, 51	6S185C10	330K
R25	6S185B69	150
R26	6S127803	1.5K; 1/4 w
R27	6S185B88	5.6K
R28	6S185B91	10K; (NRE6032AB & NRE6044AA)
R29	6S185B76	560
R30	6S128686	8.2K; 1/4 w (NRE6032AB & NRE6044AA)
R31	18C82941C03	var; 50K; incl. S2
R32	6S185A71	8.2K ±5%
R33, 41, 53	6S185B95	22K
R34, 35, 57, 61, 21	6S185B91	10K (R34 in NRE6032AB & NRE6044AA)
R37, 65	6S185B67	100
R38	6S185B61	33
R55	6S128686	8.2K; 1/4 w
R43, 54	6S185C13	560K
R47	6S127802	1K; 1/4 w
R48, 49	6S128683	150K ±5%; 1/4 w
R50	6S129982	5.6K ±5%; 1/4 w
R56, 60	6S185B89	6.8K
R58, 59	6S185C05	120K
R62	6S185C01	56K
R63	6S185B93	15K
R64	6S185C08	220K
		SWITCH:
S1	40C83270B01	push; dpdt
S2		part of ref. sym. R31
SCS1	48R869397	silicon controlled switch M9397 (NRE6032AB & NRE6044AA)
		TRANSFORMER, RF:
T1	24D82559G12	455 kc filter; 5 pin
T2	2482678C12	Coded BRN-RED: Pri: 5 turns, Sec: 140 turns; incl. 76K847159 CORE tuning
		RESONATOR UNIT, IF:
Y1	1V80768A99	ceramic, 458 kHz
Y2	1V80769A05	ceramic, 452 kHz
Y3	YVSW-102	receiver control (SEE NOTE II)
	NONREFERENCED ITEMS	
	36B82942C01	KNOB, Control
	26B82671D32	SHIELD, Oscillator
	26B82671D31	SHIELD, COIL (used with L5, L6, L7, L8, L9)
	14B05285A01	INSULATOR, can liner (used with L2)
	26B83420G01	SHIELD (used with L2)
	26B83421G01	SHIELD, COIL (used with L3)
	26B83806H01	SHIELD (used with L4)
	14C83137B01	BASE, Socket
	15B83138B01	COVER, Socket
	39B82865B01	CONTACTS
	26B82671D29	SHIELD (used with L11)
	26B83161B01	SHIELD, upper
	04B82418B03	WASHER, Insulating (used with Q1)
	0180748A70	SOCKET, Reed
	4384295H01	SLEEVE, Outer Battery
	0180748A64	SLEEVE, Inner Battery
	7682686D02	SLEEVE, Ferrite (for L9)

NHN6157A Housing Kit EPD-16604-G

LS1	50C83154B01	SPEAKER, Dynamic: coil imped, 8 Ω @ 1 kHz; 2" dia.
	NONREFERENCED ITEMS	
	1V80748A63	HOUSING, receiver: riveted
	35A82258D03	GRILLE, cloth
	15C83993D01	COVER, housing
	14B82643E43	INSULATOR, cover
	42C83644E03	CLIP, pocket
	75B82206D01	PAD, pocket clip
	41A83136C01	SPRING, pocket clip
	22B82395B21	PIN, clip
	13B83143B01	ESCUTCHEON
	43B83151B01	BUSHING, button
	38B83541C01	BUTTON, push
	41A83156B01	SPRING, compression
	42A83495B01	CLAMP, cable
	4K848065	WASHER, retainer
	4K840914	WASHER, spring
	14B83863B02	INSULATOR, speaker (clear plastic)
	43B84715H01	INSERT, battery button
	41B84716H01	SPRING, flat
	43B84717H01	INSERT, battery button
	22B82591C13	PIN, roll
	15C84718H01	HOUSING, button

"Vibrasponder" Resonant Reed EPD-16647-A

	TLN6709BE	(304.7-450 Hz)
	TLN6709BF	(450-625 Hz)
	TLN6709BG	(625-1063.2 Hz)

NLN6763A Battery Retainer EPD-22596-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1V80793A61	assy.; incl: 43B05661C01 BUTTON, 41B84716H01 SPRING, 15C84718H01 H59, BUTTON, 43B05662C01 INSERT, BUTTON

NLN8080A Nameplate Kit PLF-681-A

	33B83559E05	NAMEPLATE

NLN8707A Nameplate Kit (U. L.) PLF-682-A

	33B05288B02	NAMEPLATE

NOTES:

I. Replacement semiconductors must be ordered by Motorola Part Number only for optimum performance.
II. Crystals are part of the Radio Model only. When ordering crystal units specify carrier freq(s), crystal freq(s) and crystal type number.
III. Some radios used Q3 type M9606, replace with type M9266.

PARTS LISTS

"PAGEBOY" RADIO PAGER
406-420 MHz
450-470 MHz

68P81052A60-F